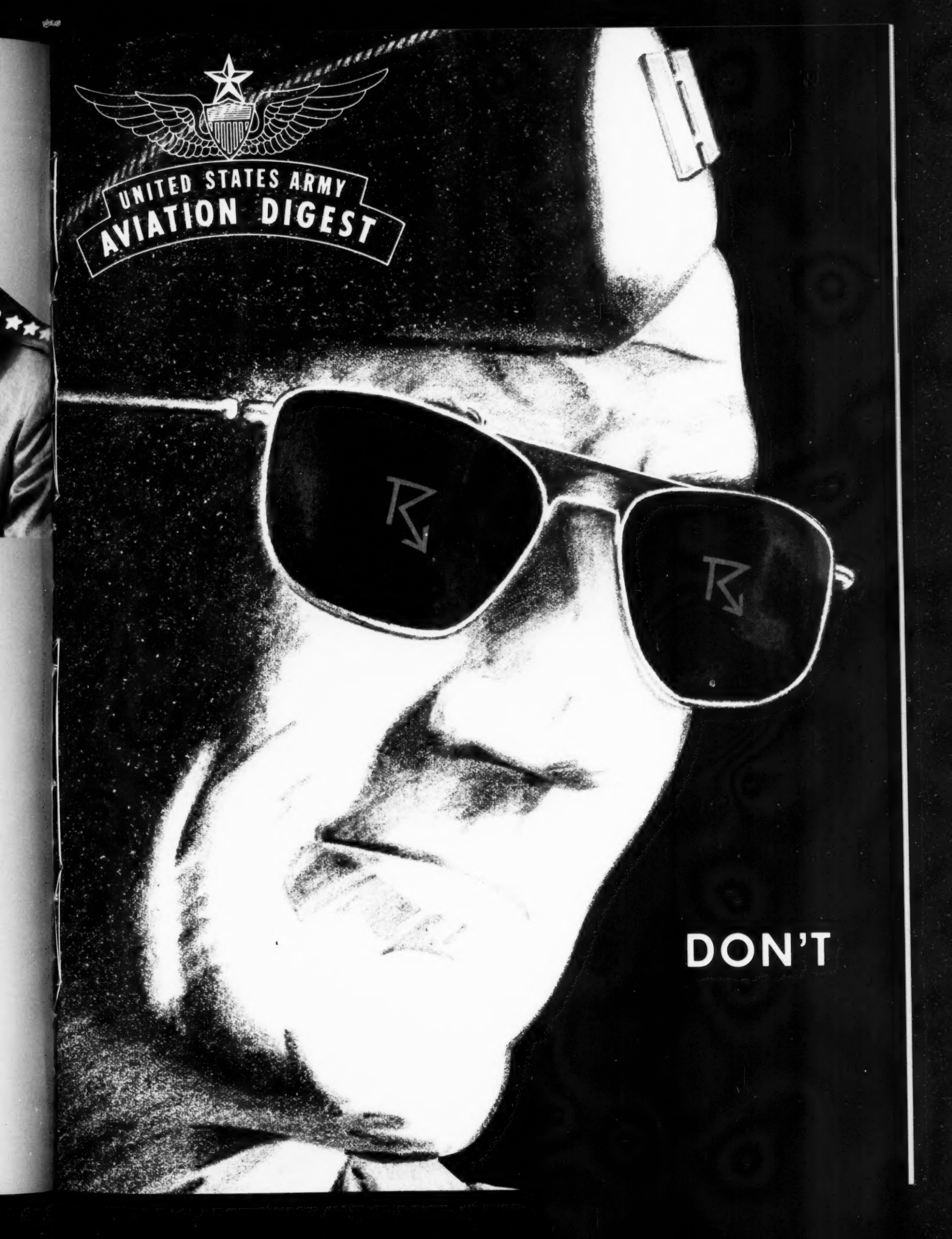
UNITED STATES ARMY
AVIATION DIGEST
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UNITED STATES ARMY AVIATION DIGEST

July 1963 Volume 9 Number 7

CONTENTS

MARGIN FOR ERROR, William R. Gaines 2

QUALITY CONTROL IN ARMY AVIATION TRAINING, Capt Charles W. Emrick 7

HOT WEATHER ACCIDENT PREVENTION 9

THIS IS BILL, Capt Gary V. Dennison 12

CHECKLIST 15

NICAD—THE DREAM BATTERY, Harvey F. Jossen 16

MAINTENANCE TRAINING 19

THE AIRSTRIP AT RANG RANG, SSgt Bob Reid, USAF 20

WIRE STRIKE 23

HELIPORT CONSTRUCTION IN LATIN AMERICA, Capt Karl L. Osterloh 24

ARMY AVIATION SUPPORT OF MAPPING IN GUATEMALA, Capt Pleasant H. West 26

SLOW, LOW AND STEEP, Maj Richard L. Jones 28

ARMY AVIATION IN RADIOLOGICAL AND CHEMICAL OPERATIONS, Capt Henry W. Meetze 30

LET'S GET WITH IT, Col Robert M. Hamilton 34

NEVER AGAIN 36

LEAVE IT OR RIDE IT? Capt Lloyd G. Gardner 38

WELL DONE 41

DRESS TO LIVE, James E. Coleman 42

CRASH SENSE 44

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The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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Margin for Error

William R. Gaines

NOBODY goes out to deliberately prang an aircraft —*but accidents do happen.* And when they do, a comprehensive investigation is set off aimed at determining the cause factors.

Over the years it has been established that these cause factors break down into three basic ingredients, each having its own breaking point:

- *the pilot,* who is likely to have an accident if he exceeds his own capability;
- *the aircraft,* which is likely to have an accident if it is flown beyond its limitations; and
- *the situation,* which is likely to cause an accident if it is misjudged.

The possibility of exceeding the breaking point of any one of these "basic ingredients" always

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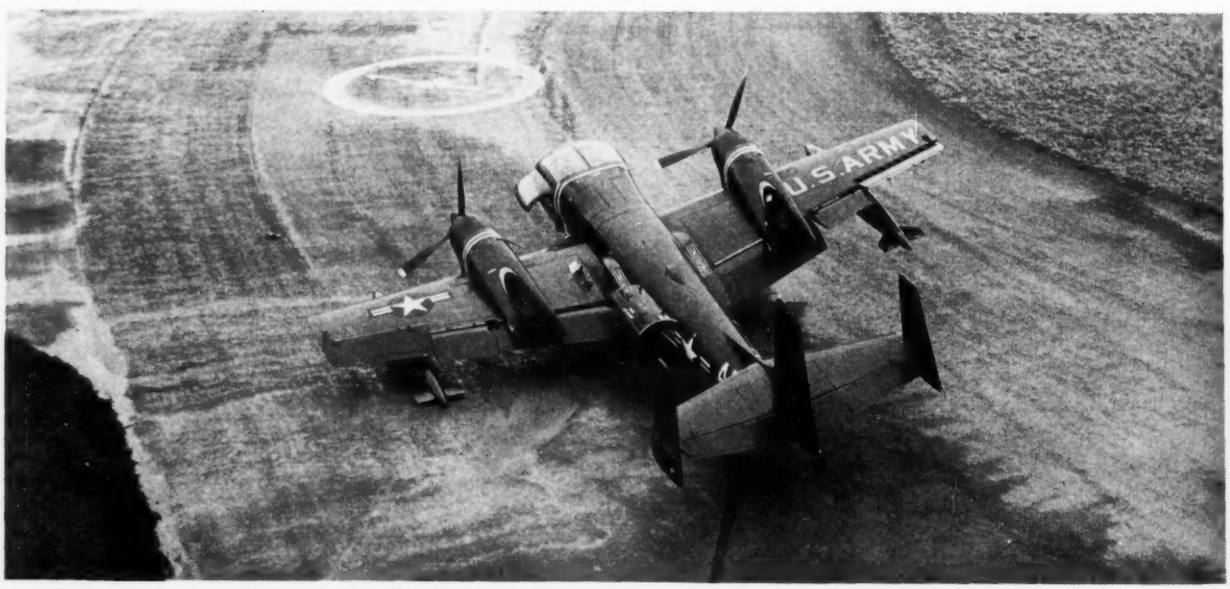
Mr. Gaines was safety director at the U. S. Army Aviation Center for 9 years. He is now deputy director of safety at Hq, USAREUR.

Result of landing Mohawk 45 feet short of runway



Result of unauthorized roll at 100 feet altitude. Two fatalities.

exists. The best way to overcome this threat is for each aviator to establish his own safety factor—to allow a *margin for error.*

THE AVIATOR

How many pilots consistently touch down in the first 50 feet of a runway, whether it be 1,700 or 7,000 feet long? Of course, you know some; and often they will boast about it. Sure, they are aiming for the end of the runway and if they continue this practice they WILL HIT IT—because they have allowed no *margin for undershoot errors.*

Not long ago a Caribou aiming for the end of a 5,000-foot runway hit 53 feet short. Result? A $40,000 hard landing. Recently a Mohawk approaching a 4,000-foot runway hit 45 feet short, causing the gear to collapse on final touchdown. Once again the pilot was not allowing a *margin for error.* These two accidents cost money. They could also have been costly in lives and grief to others. Not too long ago a pilot was performing an unauthorized roll in a Mohawk at 100 feet altitude over a civilian airport. For an inexperienced stunt pilot this is not sufficient altitude to give enough *margin for error.* Two persons died and one Mohawk was destroyed.

The items cited here which have caused accidents were all preventable by the *pilots.* If you are a real professional, you will always have your *margin for error* established. If you recall, during training you were instructed on touchdown (undershoot margin) and go around (overshoot margin) points. Do you still select them on every landing? If not, then you are not allowing a *margin for "your" errors.* You'll never become so good an aviator that you can afford to overlook this point. The top professionals make a habit of practicing this cardinal safety rule. For example, Mr. Beverly Howard, stunt pilot and president of Hawthorne Aviation Company, practices dozens of rolls *at altitude* before each show.

Result of exceeding aircraft's capabilities. Two fatalities.

The pilot's attitude toward flying is of paramount importance. He must never "show off" for himself or anyone else. A true professional endeavors to improve his technique on every flight, even if it is his 15,000th hour.

MACHINE CAPABILITIES

Now let's consider the aircraft. The −10 tells what the aircraft will carry, how long it will fly, how much fuel it will burn, and everything the pilot needs to know. If the −10 limitations are exceeded, so is the aircraft *margin for safety*. You won't always have an accident by just fudging a little, but you will by continuing to exceed an aircraft's limitations.

Often both pilot and aircraft limitations are exceeded. Last October two persons were killed in an O-1 aircraft. On a go-around, the pilot entered a right turn and spun into the ground. What happened? The pilot exceeded the aircraft's capability to fly safely. Between 175 and 190 pounds of cargo were found in the baggage compartment behind the observer. It wasn't the weight that killed the pilot and observer; it was where it was placed. The weight and balance book says it is *unsafe* to exceed the center of gravity limits. The O-1 referenced was 4.4 inches aft of the 139.7 limit. Trim tabs were full forward and there just wasn't enough control to fly the aircraft on a go-around.

Pilots in OH-13 aircraft have picked up mechanics who placed tool boxes at their feet, and then at lift off found insufficient aft cyclic to stop forward movement. What do you do? If you are lucky, possibly you can get to a running landing area. The aircraft has very definite limitations. It has been certified by qualified engineers after extensive testing. The manufacturer prepares the handbook which tells you what is safe to do, and usually also what isn't. Continued deviations from the −10 and standard maneuvers will eventually result in disaster.

Result of exceeding aircraft's capability as well as pilot's. Two fatalities.

The −10 of the O-1A states that all aerobatics are prohibited except steep turns, chandelles, lazy eights and spins. Some time ago an instructor pilot, without any known previous aerobatic training, was killed along with his student while pulling out of a split-S and then stalling into the trees. He was exceeding his own capabilities as well as the aircraft's limitations. Investigation revealed that he had shown this maneuver to previous students and would usually recover by making a high speed wheel road landing out of the bottom of the "S." As previously stated, an accident doesn't always happen the first time, but eventually it will if you fail to leave your *margin for error*.

SITUATIONS AND CONDITIONS

The pilot and the aircraft are both affected by situations and conditions. The pilot is affected by heat and cold. An aircraft doesn't fly the same in the summer as in the winter.

Several years ago one unit had a series of CH-21 accidents. They could hover and fly at their base field while loaded to maximum gross weight, but when they attempted approaches to mountain landing pads in this configuration, they crashed. The helicopter can't think, and it can only put out so much in way of horsepower. The "small" factor of density altitude (conditions) entered the picture, and according to the −10 the aircraft was over gross for the elevation.

Human factors also enter the picture. The pilot who wants to get home for the weekend or who wants to see his girl friend is prone to reduce his *margin for error*. He has been known to fly into weather he would not normally challenge. He will hurry his flight plan preparation and preflight. In such a situation he must realize that his *margin for error* should not be sacrificed.

Last year a pilot in an O-1 on a VFR flight plan found weather rapidly deteriorating. Fifty miles west of destination, unable to maintain VFR, he asked for a GCA. He completed his approach with 6 or 8 minutes fuel remaining. He could not have made an alternate.

Why did this pilot reduce his margin and take such an out-

right gamble? He had "get-home-itis"; it was getting dark and he didn't want to spend the night in a town just 50 miles from home.

Have you ever been weathered in at some small isolated place for several days, with less than two bucks in your pocket and starting through your dirty socks and underwear the second or third time? This is a situation that will at times affect a pilot's judgment and cause him to reduce his *margin for error.* "Get-home-itis" can be fatal. It is common to all aviators. Recognize its symptoms and reasonable precautions will cure it.

ACCIDENT PREVENTION AND MISSION ACCOMPLISHMENT

When should we reduce the *margin for error?* In the military this is very simple: when urgency of the mission requires it. If it is necessary that a commander be transported to a definite point by a prescribed time, then *margin for safety* must be reduced accordingly, but never to the point of impossibility. There will be times when no aircraft, or pilot, can make it. The best qualified pilot should be selected for any flight which has an element of risk or hazard. Often the pilot's decisions will mean the difference between mission failure and mission accomplishment. The urgency of the mission dictates how much the *margin for safety* must be reduced. But even under life and death circumstances the situation must be evaluated, because a serious accident won't improve things. "Accomplish the mission—in the safest possible way."

During a recent crisis an O-1A was lost when the pilot delivering the aircraft to the emergency area was forced to land because of weather. He failed to heed what he had been taught in flight school about touchdown and go-around points. He landed the aircraft long and used excessive brakes, causing the aircraft to flip and come to rest inverted. Result: major damage, *mission not accomplished,* plus many hours of work by the recovery crew and investigating board.

Few things are more useless in combat than a wrecked aircraft. An aircraft destroyed because of a pilot overextending his own capability or the aircraft's capability is just like having it shot out of the air by the enemy. By the same token the loss of some $13 million in damage to Army aircraft last year (not counting injuries and fatalities) would not have been nearly so severe had the pilots not overextended their own ability and their aircraft's capability.

Result of forced landing caused by weather

With more complex aircraft, accident costs continue to rise. Today the average Army aircraft accident cost is over $31,000. A large portion of these accidents can be prevented by properly evaluating your *margin for error* and aircraft limitation factors coupled with existing situations. When these factors are ignored, a pilot usually gets a lot of first-hand advice about pilot error—from the accident investigation board. It is the responsibility of each pilot and commander to point the finger at himself and his unit *before* the accident occurs. It will be time and effort well spent.

REALISM AND ACCIDENT PREVENTION

Realism in training is a very essential element. The accident prevention program and regulations must allow for realism. They are compatible.

Let's consider forced landing training. Years ago, CAA stopped carrying simulated forced landings to within a few feet of the ground. Partial or complete engine failures upon application of the throttle made it hazardous. It was found that there was ample time for a safe recovery if termination was made between 100 to 200 feet. It also could be determined whether the pilot would have made the field. Realism, compatible with a *margin of safety,* was achieved.

Army directives restrict engine shutdown in multiengine training below 4,000 feet. With aircraft such as the U-8D, this is a safe altitude. An instructor pilot may demonstrate an approach and landing with a shutdown engine and this certainly isn't unnecessarily hazardous for the element of realism gained. BUT—when an emergency go-around in this situa-

The result of a practice touchdown autorotation

tion is required, nothing short of a top quality instructor pilot can cope with the aircraft. Most restrictions such as this one have been written after hard experience.

Simulated forced landings to the ground in helicopters is a controversial subject among pilots. Today they are restricted to courses taught at the schools and in formal transition by a qualified instructor pilot. This restriction came about after large numbers of major and minor accidents occurred on practice autorotation touchdowns. What is lost by coming to a hover at 5 feet? Most pilots agree that at 5 to 10 feet altitude it takes more technique to make a smooth power recovery than to continue on to the ground. How often has anyone with an actual engine failure been injured after making it to a suitable landing area with skids level at 5 feet.

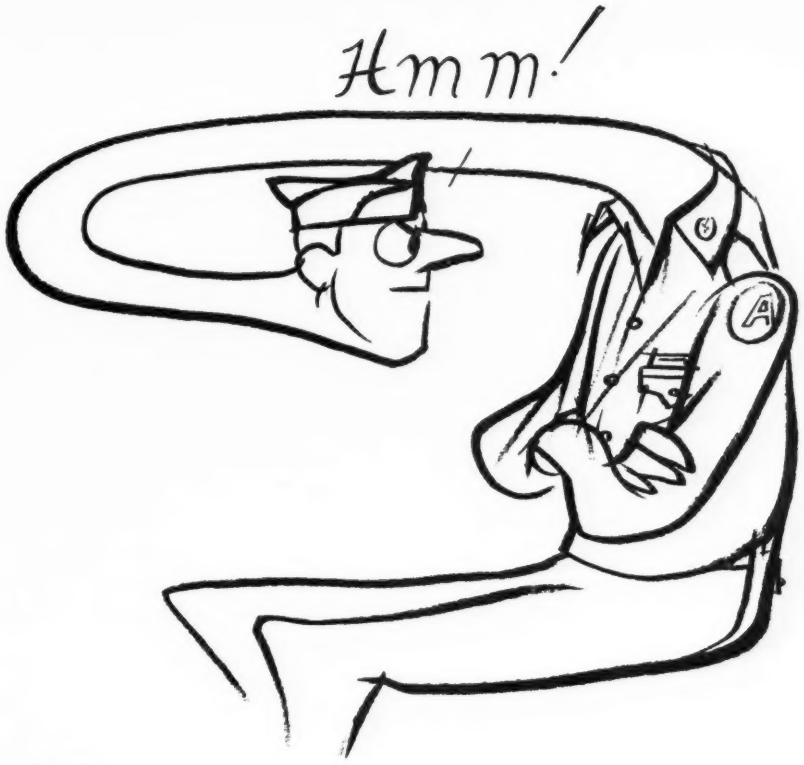
Imagine yourself flying over a sparsely wooded area at 1,000 feet above the terrain and you have an engine failure. What is the most important thing at this time—a smooth touchdown? You're dead if you don't keep your rpm and make that clearing! So why should so much emphasis be placed on touchdown when the other two items are so vital to your staying alive? Last year 109 of 147 autorotation accidents were on practice touchdown autorotations.

Where realism and accident prevention are compatible, the value of the training to be gained must be weighed against cost of the accidents. As previously stated, accident prevention in a military operation can only go so far; that is until it begins to preclude mission accomplishment.

Army Aviation must operate in the nap of the earth. To general aviation this is an unacceptable risk. To Army Aviation it is the required mission, and to accomplish it *margins for error* are less than that of general aviation. Air cavalry units have proved that nap-of-the-earth flying can be done with relatively few accidents. They have very aggressive accident prevention programs in the air as well as on the ground. Their accident rates while flying at treetop level and below are much less than those of some other Army Aviation units. All air cavalry pilots have their *margins for error,* even though reduced, and allow for aircraft limitations. This prevents accidents.

The pilot and the aircraft are a team. They are usually capable of mission accomplishment if in each situation accident prevention is not overlooked. Don't forget your *margin for error!* And remember—what really counts in the final analysis is not how well you can fly, but how well you do fly.

Nap-of-the-earth flying can be done safely; just remember your margin for error!



The search continues for a guaranteed method to determine the effectiveness of USAAVNS training. The latest proposal is described below.

Quality Control in Army Aviation Training

Captain Charles W. Emrick

MANY AVIATION units in CONUS will be visited by a team of two officers from the United States Army Aviation School during the period 15 Aug-24 Sep 63. The purpose of the visits will be to gather information to be used in determining effectiveness of USAAVNS training. Field performance of graduates will be compared to school performance to determine whether or not school standards are at the correct level. Is the School eliminating potentially good aviators with high standards, or producing an undesirable product with low standards? Or is it at the correct level, producing effective graduates now?

The present graduate 6-month questionnaire method of quality control has not been effective due to the poor return. Twenty percent of all graduates receive questionnaires, and last year only 40 percent of the 20 percent were returned. Accurate analysis cannot be made with this small sample, and the on-site interview will at least give an accurate 25 percent sample. The on-site interview, if successful, will replace the questionnaire method.

The proposal was made last October to send teams of officers to units in the field to determine the effectiveness of the recent USAAVNS graduates. The idea was not to check unit standards; rather it was a quality control measure for the school to check on its end product: the graduate.

CONARC approved the plan on 4 March 1963 and work was initiated to implement the trips.

It was decided to use calendar

Capt Emrick is the Training Analysis Officer, Standards Division, DOI, at USAAVNS. He is dual rated with approximately 1200 flight hours.

year 1962 graduates of the Officer Fixed Wing Aviator Course, Officer Rotary Wing Aviator Course, and Warrant Officer Rotary Wing Aviator Course as the sample and to make the visits only in CONUS.

The initial idea was to interview the graduates themselves. But research and co-ordination with other services indicated that more effective information could be obtained by interviewing the commanding officers of the graduates as well as the unit operations officer, maintenance officer, safety officer and unit IPs.

Of the 972 graduates, of the courses indicated, 320 were assigned in CONUS. Lists of all aviators in the CONUS Army areas were obtained and the 320 graduates were located by assignment, post and unit.

Routes were selected so that the greatest number of graduates could be reached in a 30-day trip.

One team will cover the western portion of the United States and travel by commercial air, while a second team covers the eastern part of the country in a U-6A. The two methods of transportation are being used to evaluate costs for future trips.

TEAM B, U-6A

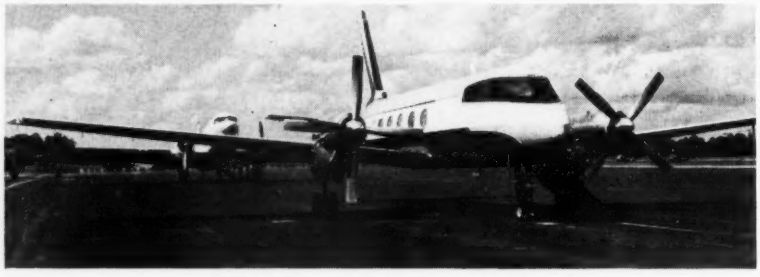
Ft Rucker to Ft Knox	24 - 27 Aug
Ft Knox to Ft Devens	28 - 29 Aug
Ft Devens to Ft Jay	30 - 31 Aug
Ft Jay to Indiantown Gap	1 - 2 Sep
Indiantown Gap to Ft Belvoir	3 - 4 Sep
Ft Belvoir to Ft Lee	5 - 6 Sep
Ft Lee to Ft Eustis	7 - 9 Sep
Ft Eustis to Ft Bragg	10 - 14 Sep
Ft Bragg to Ft Campbell	15 - 19 Sep
Ft Campbell to Ft Benning	20 - 24 Sep
Return to Ft Rucker	25 Sep

The "West" team departs Fort Rucker 15 August and returns 15 September 63. The "East" team departs 24 August and returns 25 September. The itinerary shown is subject to change.

The stops on the two routes were arrived at commensurate with the number of graduates assigned to particular locations. Eighty-one graduates are assigned at Fort Rucker, and their commanders will be interviewed before the teams' departures.

Visits are on a trial basis this year. If found effective, it is anticipated that in 1964 visits will be made worldwide to graduates of all USAAVNS courses.

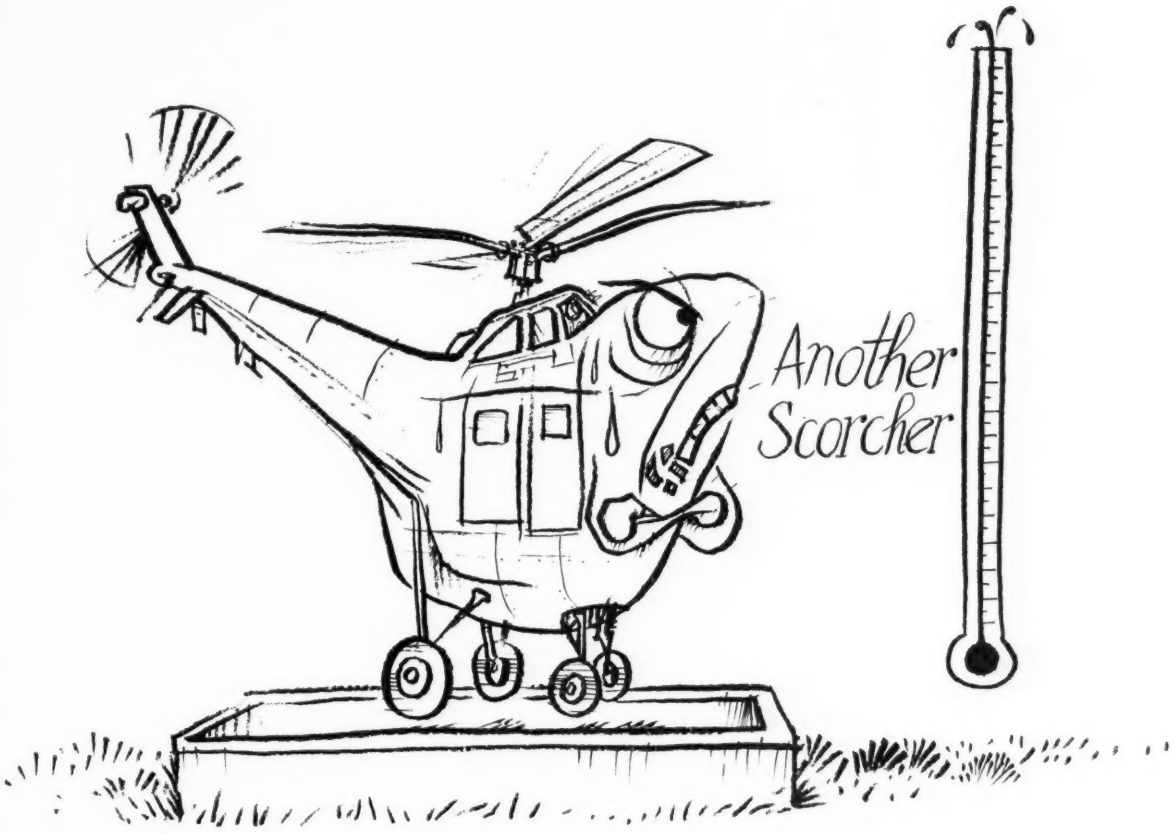
The teams will consist of two officers from Standards Division, Office of the Director of Instruction, and one member each from Department of Advanced Fixed Wing Training and Rotary Wing Training. Commanders of the units to be visited will receive letters stating the date of the visit and the names of the graduates we will be concerned with.



TEAM A, Commercial Air

Ft Rucker to Ft Polk	15 - 16 Aug
Ft Polk to Ft Sam Houston	16 - 17 Aug
Ft Sam Houston to Ft Hood	18 - 23 Aug
Ft Hood to Ft Sill	24 - 27 Aug
Ft Sill to Ft Bliss	28 - 29 Aug
Ft Bliss to Ft Huachuca	30 Aug - 2 Sep
Ft Huachuca to Ft Ord	3 - 5 Sep
Ft Ord to Ft Lewis	6 - 7 Sep
Ft Lewis to Ft Carson	8 - 11 Sep
Ft Carson to Ft Riley	12 - 13 Sep
Ft Riley to Ft Chaffee	14 - 15 Sep
Return to Ft Rucker	15 Sep

Cockpit Crossfeed, prepared by the United States Naval Aviation Safety Center, has some good tips for chopper pilots. We think they are worth passing along. We've made the copy applicable to Army Aviation where necessary.



Hot Weather Accident Prevention

WITH THE approach of hot weather it is time to review the hazards of hot weather flying and direct our attention to the problems of flying in high temperatures, high humidity and high pressure altitudes.

With a proper understanding of the effects of hot weather on the performance of helicopters, proper flight planning, a professional approach to the problem and strict adherence to the SOPs, a summer of safe flying can be achieved by Army Aviators everywhere.

How does hot weather affect the performance of the helicopter? First, low density air near the ground (i.e., high density altitude) is associated with summertime high temperatures and high humidity which causes a loss of lift by decreasing available engine power. As much as a 12 percent loss of BHP can result from high humidity alone, and must be accounted for in critical performance conditions. The reciprocating engine operates with a fixed displacement and all air processed is directly associated with the combustion process. If water vapor enters the induction system of the reciprocating engine, the amount of air available for combustion is reduced and since most carburetors do not distinguish wa-

ter vapor from air, an enrichment of the fuel-air ratio takes place. Increasing the temperature of the inlet air (again, decreasing the density) permits the carburetor to supply an excessive amount of gasoline and further enriches the mixture. The maximum power output at takeoff requires fuel-air ratios richer than that for maximum heat release so further enrichment will take place with subsequent loss of power.

Second, as the density altitude increases the efficiency of the rotors decreases. Lift coefficient is dependent on the shape of the airfoil, angle of attack and the mass of air which causes the lifting force. As the altitude and/or temperature increases, the density decreases, thus reducing the lift coefficient.

Appreciating the general effect of hot weather and high density altitude, how do we use the above information in actual practice? We know from a look at the records that hot weather helicopter accidents usually fall into two categories: (1) Pilots failing to take into consideration the factors of high density altitude and misjudging distance and altitude. (2) Loss of power due to repeated use of maximum power with a few overboosts thrown in.

In order to keep landing accidents in helicopters to a minimum during the summer months, frequent review of landing technique must be accomplished. The steep flare prior to landing should be minimized. On a hot day, the rate of descent increases and the flare effectiveness is reduced. The gross weight of the helicopter must necessarily be decreased so that effective control can be maintained. Pilot techniques must take into account the requirement for initiating a landing flare at sufficient altitude to preclude hard landings.

Missions must be assigned within the capability of the helicopter, the pilot's training level, and the existing weather conditions.

Rotor RPM control is more critical during high density conditions. Pilots should concentrate on RPM control in the landing and takeoff phase of flight in order that overboosting the engine will not occur and "turns" will not be lost.

Each pilot must assume a specific duty during the different phases of flight. In a hover, while one pilot is concentrating on position for external cargo hookup or hoisting operations, the other pilot must monitor the rotor RPM at all times.

One of the critical maneuvers during high density altitude conditions is the autorotation. Depending on the state of training, units should consider placing a density altitude limit on practice autorotations.

It must be remembered that thunderstorm activity will be increasing as it gets warmer. The turbulence encountered in a thunderstorm will make the control of the helicopter extremely demanding on the pilot. Pilots should be aware of the increased blade stall tendencies during such conditions. Best bet when confronted with a thunderstorm is to slow down, keep the turns up and land as soon as a suitable site is available. The thunderstorm will pass over in approximately 15 to 20 minutes. Be sure that you transmit your intentions to the nearest radio facility.

Hot Weather Accident Prevention Tips

Conduct a good weather briefing before each flight. Compute the maximum allowable gross takeoff weight prior to every takeoff. Always check the power required on gross load flights in a hover and ensure that an extra three to four inches of MP is available as insurance. When certain weather factors are not known, approaches must be started with a safe, higher than normal, RPM in order to anticipate extra power needed. Abrupt power changes should be avoided to prevent momentary or complete engine stoppage and overboosts. During autorotations the RPM must be monitored very closely to prevent rotor overspeeds. Report ALL or suspected rotor overspeeds and engine overboosts. Pilots must plan ahead on each maneuver taking into account the effects high density altitude will have on the execution of the maneuver. Landing sites must be selected that will enable the pilot to make a hot weather type approach. Following the SOP right down the line will prevent high density altitude "goof-off" type accidents.

This Is Bill

Captain Gary V. Dennison

HIS NAME IS Captain Bill Swarens. He works in an office, dispensing Army Aviation advice to the division he supports. At night he drives home and slumps tiredly in "his" chair. "My aching back," he complains to his wife, "that place wears me out worse than working on the farm did."

"Don't you worry, dear," his wife says soothingly. "I've fixed you a good dinner—homemade hot rolls, steak, potatoes and gravy, and chocolate pie for dessert."

"Sounds great!" says Bill as he reaches for the evening newspaper. "I sure am hungry."

Bill shows his appreciation for the homemade rolls by eating six of them. Each one is tenderly loaded with real butter, and just as the butter begins to melt, Bill pops them into his mouth, one after the other. "These are tremendous," he tells his smiling wife. "I'm so full; let's wait awhile for dessert."

Capt Dennison is assigned to the 4th Avn Company, Fort Lewis, Wash.

Actually Bill should feel full. His stomach is filled to capacity. During this one meal Bill has consumed over 3,000 calories. His total intake for the day exceeds the amount of fuel needed to maintain two men doing heavy labor, and there's more to come. Later in the evening, during his favorite TV program, Bill eats two pieces of chocolate cream pie. Then he goes to bed distressingly satisfied.

The next day, as on other days, Bill smokes too much, feels dizzy if he bends over too fast, has "that tired feeling," and wonders why he is so jumpy.

This is Bill—and Bill could be anyone who fails to use his body the way it was designed, as a machine requiring care and maintenance. He is rundown, overweight, and indifferent—a very common man in our society.

If Bill wants to go through life half a man; wants to die earlier than can be expected; if his insurance is full and in force, then it is his decision. But what about Bill as an Army Aviator? Doesn't he have a responsibility to himself and to his future passengers to be as physically and mentally fit as possible?

The obvious answer is "yes." He does have that responsibility, both as an officer and as an Army Aviator.

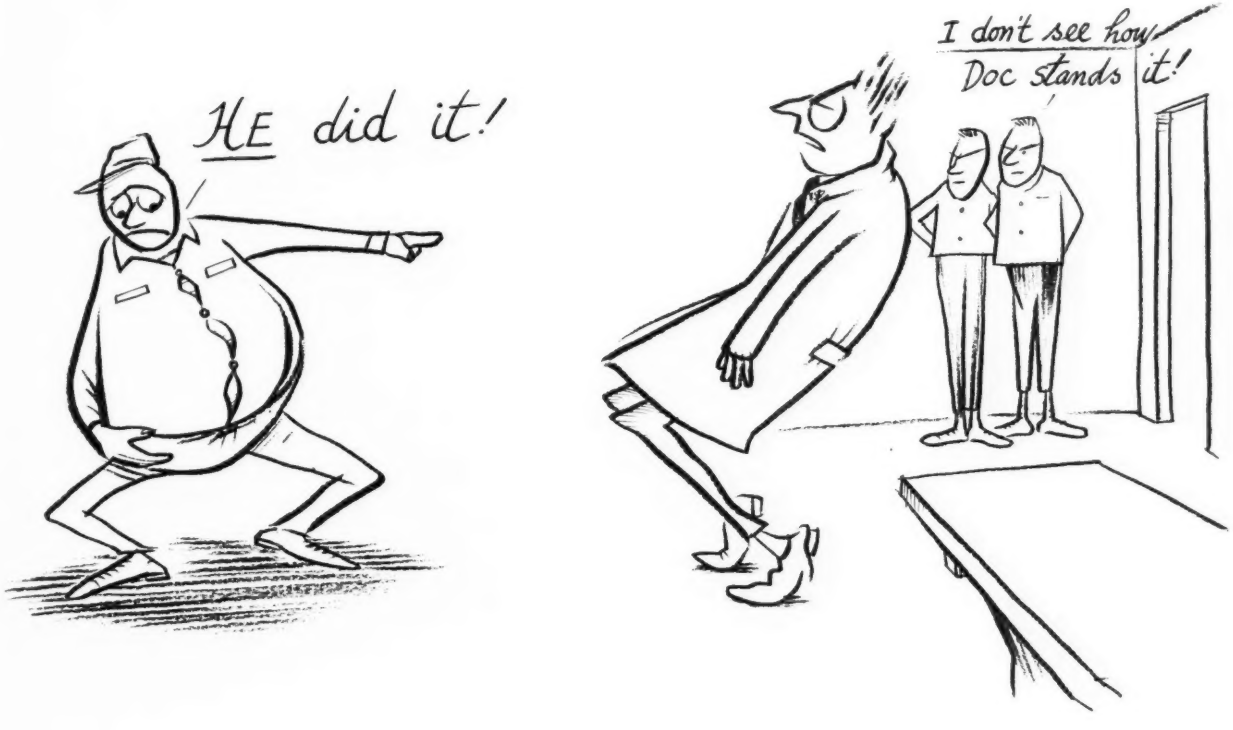
How can Bill be helped? What secret formula can he use? Is a 50-mile hike the answer? Or is it a rigorous physical training program?

Not necessarily. This officer is a bit lazy and probably wouldn't stick to such drastic measures. Yet, a person can change his whole life with a few simple steps.

He can exercise. Not much, mind you; 15 minutes a day, EVERY DAY, and I stress this point, is sufficient. These exercises can be simple ones, the kind that don't make you sore the next day. Muscles can only grow so fast, so why should he punish himself? Regularity, increasing the speed of these exercises, and time will tone Bill up amazingly fast when you consider how long he's been going down hill. A little exercise relaxes nerves, aids sleep, and gets rid of "that tired feeling."

Physical conditioning leads invariably to mental conditioning. It's a bit of a mystery why, but it is a sure fact. A man who thinks enough of his body to exercise it suddenly begins to want to keep that waistline down, those lungs cleaner. It becomes a challenge. Some people even enjoy it, when one day they look in the mirror and notice that their arms, legs, and shoulders are a little bigger, a little harder.

Maybe this will happen to Captain Bill Swarens. Let's hope so. He's a pretty nice guy.

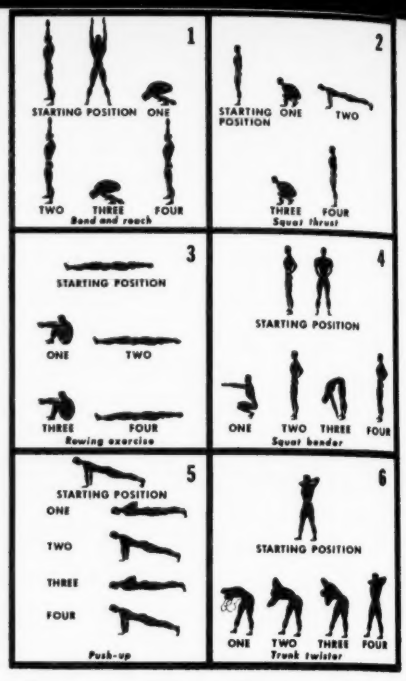


From "Streamlining Your Waistline" January 1963, ARMY INFORMATION DIGEST.

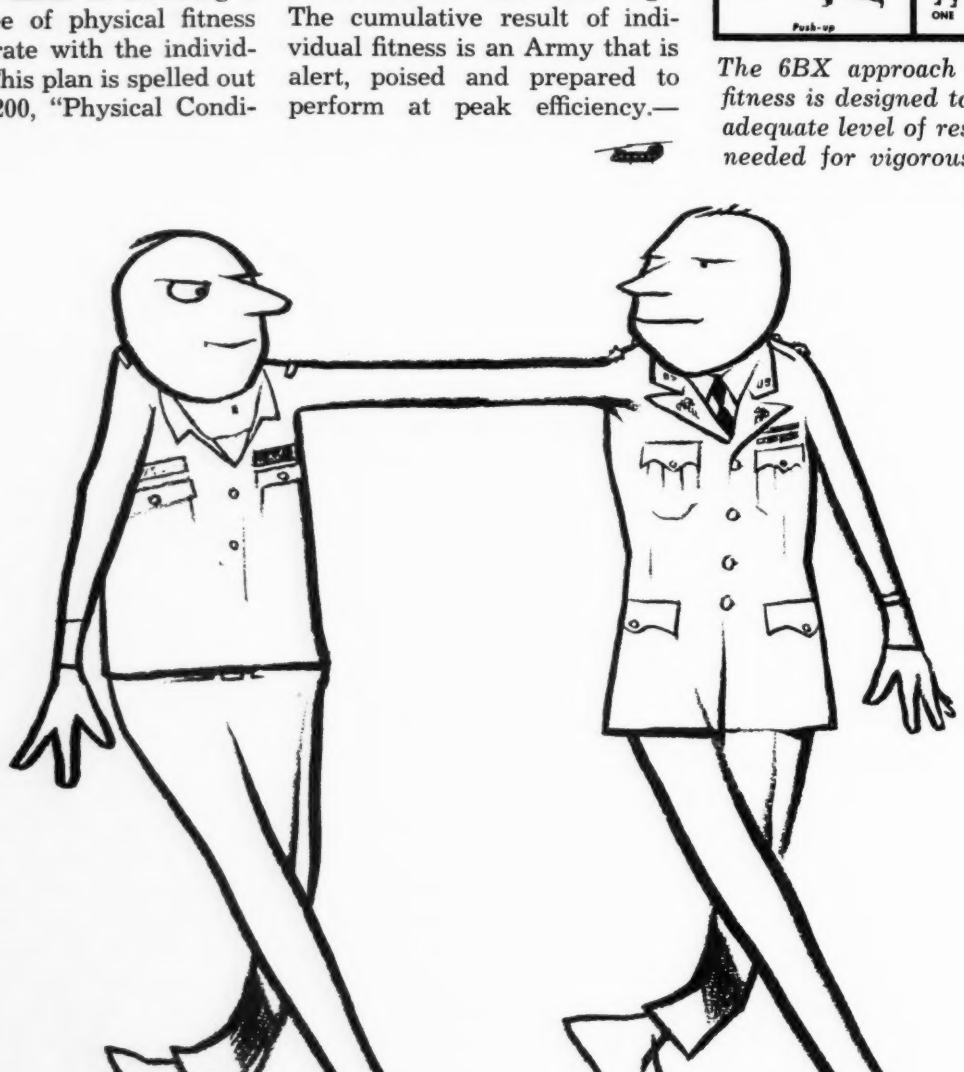
Approximately 90 percent of weight reduction is due to dieting. Although exercise is extremely beneficial as an adjunct, it will not in itself effect much weight loss without an accompanying dietary regime. It does, however, serve to reinforce the soldier's awareness of his own physical fitness and well-being.

The Army has developed a program of graded exercises planned to assist in attaining a high degree of physical fitness commensurate with the individual's age. This plan is spelled out in TM 21-200, "Physical Conditioning," and FM 21-20, "Physical Training." Still another plan which is more readily adapted for individual use is the Six Basic Exercises (6BX) Plan—a modification of the 5BX Plan used by the Canadian Army. (See box.)

All in all, these diet and exercise plans have worked well for those who conscientiously abide by and rigorously follow through with them. They are designed to assist all Army members to reach and maintain a high state of physical fitness commensurate with their age. The cumulative result of individual fitness is an Army that is alert, poised and prepared to perform at peak efficiency.—



The 6BX approach to physical fitness is designed to develop an adequate level of reserve energy needed for vigorous well being



Checklist

BEFORE DEPARTURE

1. Flight planned around known thunderstorm areas whenever possible.
2. Airborne radar operative if flight scheduled to pass through thunderstorm area.
3. In aircraft not equipped with radarscope at pilot's position, navigator or observer on board to operate equipment.
4. Aircraft—particularly cockpit—clean and free from debris and dirt which could blind or hamper pilot.
5. Radar monitor departure requested if buildups within range of departure station radar.
6. Loose equipment tied down.
7. DO NOT TAKE OFF INTO THUNDERSTORM.

PRIOR TO ENTERING THUNDERSTORM AREA

1. Best altitude selected in event of inadvertent penetration.
2. Ground radar sites contacted for advisories and possible assistance.
3. All personnel seated and safety belts fastened. (This requirement applies to flight examiners as well as others. Care should be taken to awaken sleeping aircrew members.)
4. Aircraft equipped with radar should constantly monitor and alter flight path necessary to miss intense buildups by 10 miles or more. (Twenty-mile clearance is best if possible.)
5. Get out of the 16,000-22,000 foot altitudes.
6. Recheck tiedown security. Constant vibration and shifting of stress points in flight usually loosen cargo tiedown chains and straps.

RADAR TECHNIQUES

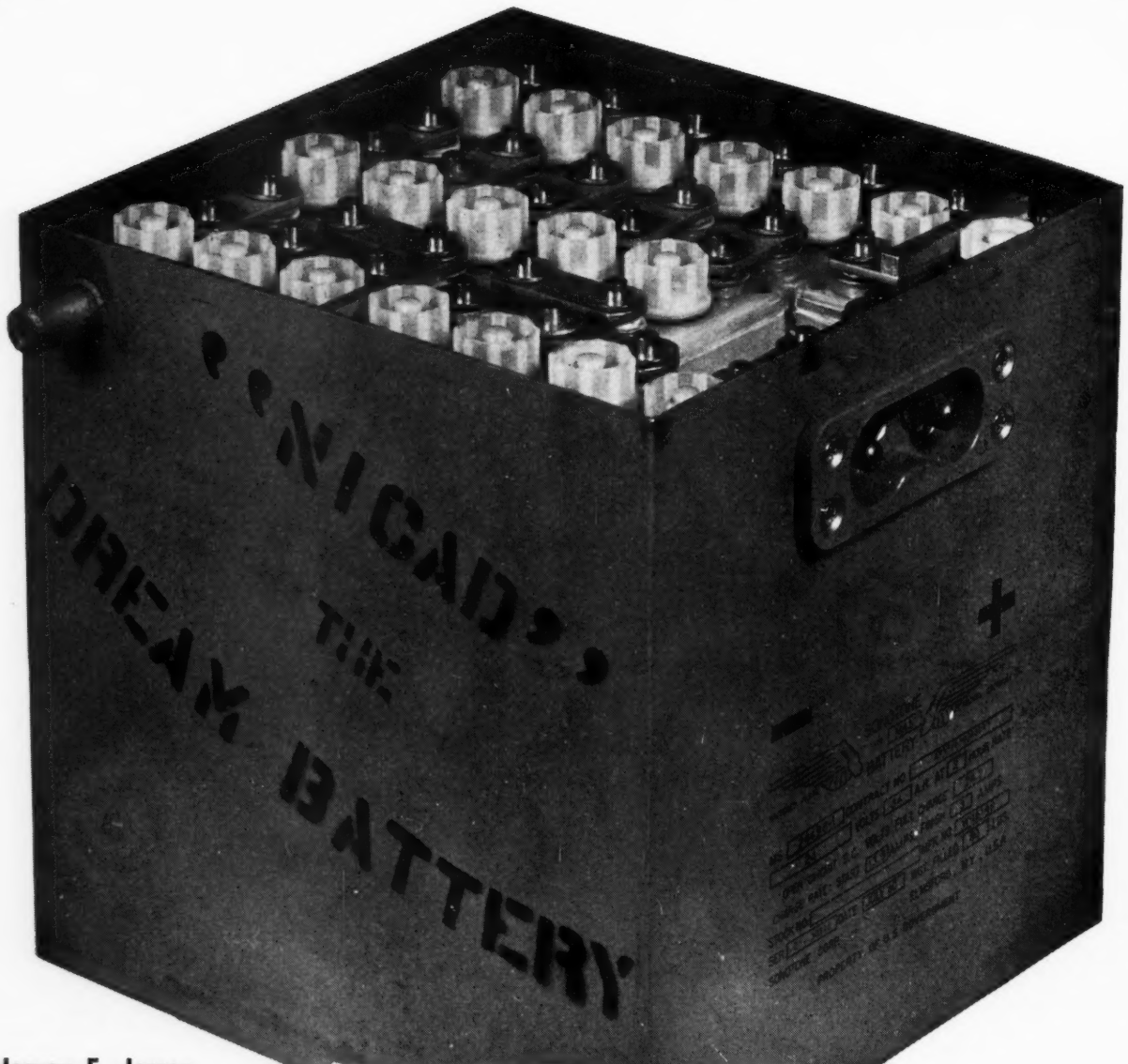
1. Use iso-echo, or if this feature is not available, a constant low gain setting.
2. Take particular care to avoid storms with hooked "fingers," figure six echoes, sharp rainfall gradients, and rapidly changing shapes.
3. Never fly under the overhang of a thunderstorm.
4. A 30-mile range setting is good, but an occasional check of the longer ranges should be made to avoid flying into a blind alley.
5. Antenna stabilization switch on.

IF YOU GET IN A THUNDERSTORM

1. Follow the proved techniques—RIDE WITH IT; DON'T FIGHT IT. Fly the attitude gyro. Avoid excessive control movements.
2. Cockpit lights up bright.
3. Once airspeed is established at best penetration airspeed as directed in flight handbook, do not vary power excessively from the known power settings. Expect large and erroneous variations in all pitot-static system instruments.
4. If aircraft is struck by lightning, check accuracy of compasses when things settle down a bit.
5. In reciprocating engine aircraft, increasing prop rpm will help stabilize the aircraft.

AFTER FLIGHT IN THUNDERSTORM OR TURBULENT AREA

1. Consider precautionary landing based on severity and resultant damage from flight in turbulent air.
2. Make immediate inflight pilot report to both air traffic control and military metro if possible. You may save another pilot a great deal of trouble.
3. It may be desirable to perform a check at altitude for handling characteristics of the aircraft in the landing configuration. *Do not permit aircraft to stall.* If runway length and other conditions are satisfactory, consider adding a few knots to normal approach airspeeds.
4. Write up the incident in the Form 2408-13 and request a complete check of the aircraft by a qualified maintenance activity. Your judgment is the deciding factor in determining the need for this step.
5. Debrief weather forecaster on location and extent of storm.



Harvey F. Jossen

IF YOU HAVE ever had to service or maintain a battery (and who hasn't?), how many times have you wished that somebody, someday would invent some super battery that wouldn't go dead in freezing weather, that wouldn't require constant checking of the electrolyte, that would easily recharge in less than an hour, and that would last and last and last?

Strangely enough this super futuristic space age concept of a perfect battery has been with us since the 1890s, when the first nickel-cadmium battery was invented by two European scientists.

In its present improved form, as made by the Sonotone Corporation and used in Army aircraft, the nicad (nickel-cadmium) battery has all the above characteristics and some others that seem little short of amazing. For example: The electrolyte (potassium hydroxide in distilled water) does not enter into any chemical reaction, but acts as a conductor of current between the plates. The active material of the negative plate is cadmium oxide and that of the positive plate is nickel oxide. None of this material sheds, flakes, or is lost. The plates are manufactured by using a sinter-

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Mr. Jossen is an instructor in Aircraft Systems, Dept of Maintenance, USAAVNS. He has approximately 15 years experience in aircraft maintenance.

ing process. This so increases plate area that, compared to a lead-acid battery, the active material in a nicad battery is multiplied several hundred times without corresponding increase of weight.

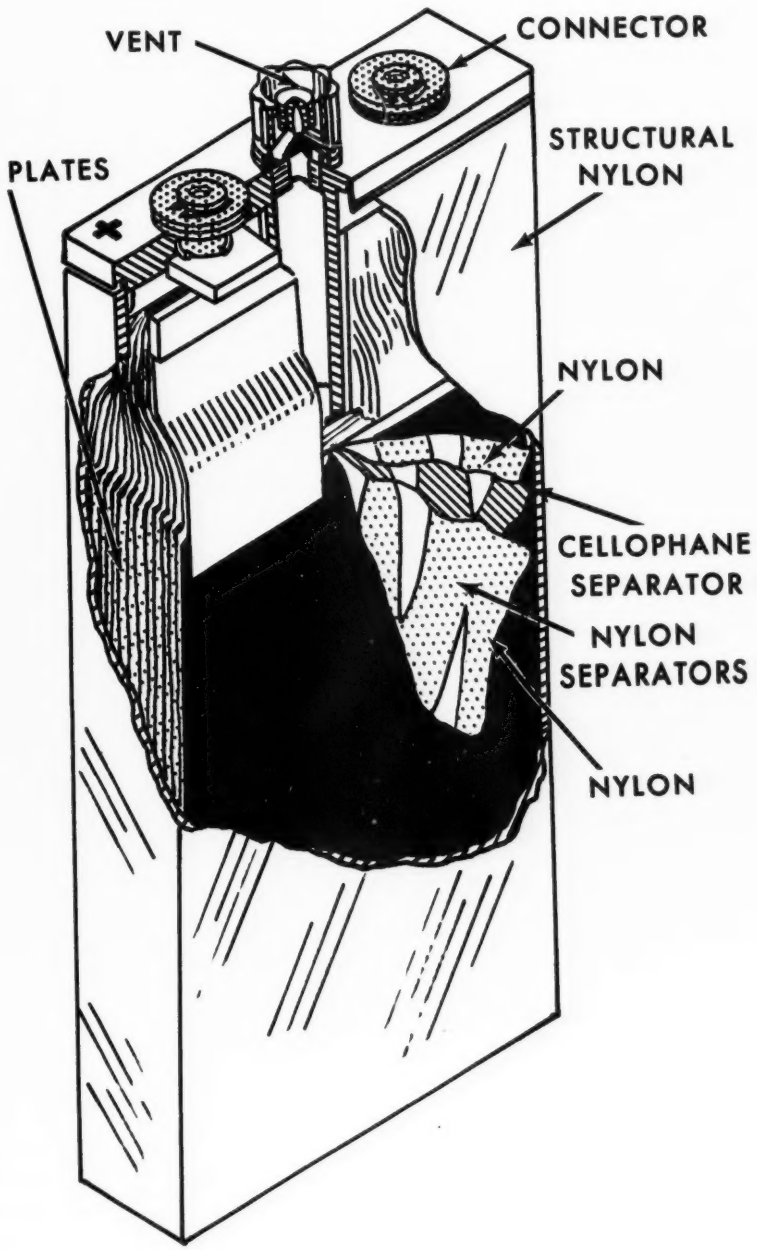
Sintering is accomplished by fusing microfine nickel powder at very high temperature to the fine mesh nickel screen to form a highly porous structure called a plaque. The plaques then are impregnated electrochemically with the active materials: nickel hydroxide for the positive plates and cadmium hydroxide for the negative plates. The surface of such a sintered plate appears to be quite smooth, but a closer look with a magnifying glass will disclose a maze of tiny hills and valleys. The effect of this is to put so much "muscle" into a nicad battery that some models will furnish up to 2000 amps peak for jet starts.

Due to the extensive use of molded nylon in its construction and the dense method of assembly (no sediment trap is needed on the bottom), the cell has a structural solidity that withstands extreme vibrations and shock.

A gas escape valve on the cell plug opens past 5 psi. As no gas is produced on discharge, the cell vent remains sealed, preventing the entrance of foreign material and the loss of electrolyte.

No great problem arises during cold or hot weather operation, as the battery will accept charge at temperatures as low as $-65°$ F and as high as 165° F. This is far beyond the limits for lead-acid types. The state of charge is shown by the amount of current the battery draws when connected to a constant-potential charging bus. Battery voltage and specific gravity vary little.

CUTAWAY VIEW, NICKEL CADMIUM CELL



The newness of the nicad battery in American aviation has not permitted the buildup of an impressive array of statistical material over years of use. However, here are some facts that do set it apart from the familiar lead-acid battery:

- It can operate as long as 1,000 hours without requiring service of any kind. In an actual test, one of these batteries remained in continuous service for 5,000 hours without being removed from the aircraft for servicing.
- The price for a 24-volt nicad battery is from $450 to $1,360 each, depending on the model.
- The average nicad battery is only one-third the weight of a conventional lead-acid battery.
- At present the Army uses the nicad battery in all turbine powered aircraft, the U-8D, U-8F, and CV-2B.
- The nicad may be recharged thousands of times. Recharging takes only ½ hour from dead to full charge.
- The nicad will discharge in any position, furnishing a flat voltage output over 90 percent of total discharge time.

Keeping the battery clean and dry will do much to guarantee peak performance. The buildup of metallic dust or any conductive material will provide a conductive path and permit self-discharge of the cells. Metal objects and flames should be kept away from the exposed parts of the battery. A tool accidentally dropped could easily cause a short circuit and damage to the cells.

At times a white deposit (potassium carbamate) may collect around the tops of the cells. This should be flushed with tap water. DO NOT USE SOLVENTS, ACIDS, OR ANY CHEMICAL CLEANER. The plastics used in battery construction may be injured. A bristle brush may be used to clean stubborn dirt, but do not use wire brushes. Be certain to drain off excess water and dry the battery, using compressed air if available.

In adjusting the liquid level, it is very important to use only distilled water. Tap water may contain chlorine, softening agents, and other foreign material, all of which may contaminate the battery.

Very seldom will it be necessary to add water or electrolyte to the battery. If more than one ounce of electrolyte is spilled from any cell, the electrolyte will be replaced with potassium hydroxide, reagent grade, specific gravity 1.32.

If you are required to prepare the electrolyte, remember that considerable heat is generated chemically when mixing electrolyte. Therefore, *always pour the potassium hydroxide into the water slowly and allow it to dissolve.* If water is poured into the potassium hydroxide, the rapid heat generation will likely throw the electrolyte upon the operator. This will have the same effect as being wet by a lye solution. If any of this highly corrosive electrolyte is spilled on the hands, clothing or other material, it should be flooded immediately with cold water or three percent boric acid solution. Consult a physician if the eyes are involved. Always use rubber gloves, aprons, and face shields when handling potassium hydroxide.

In maintaining the nicad battery, care must be taken not to contaminate the venting system, especially with jars or tubes previously used for the lead-acid battery. The electrolyte for the nicad is highly corrosive potassium hydroxide, which is chemically opposite the corrosive sulfuric acid used in the lead-acid battery. These two electrolytes could neutralize each other if allowed to come in contact, even in vapor form.

Summarizing the advantages of the nicad battery:

There is no deterioration of battery materials during storage, regardless of the state of charge.

Nickel-cadmium batteries will hold a charge much longer during storage than will lead-acid batteries.

It can be recharged in an hour or less.

Voltage remains steady even at high discharge rates.

It is not damaged by freezing, vibration, or jolting.

No permanent damage done by improper charging.

No corrosive fumes.

Cells are individually replaceable.

No capacity test needed to check cell condition.

It can be stored indefinitely in a charged condition.

Much less improved varieties of the nickel-cadmium battery have been used for many years in European buses, communications, and industry. Some of these same batteries have remained in service as long as 25 years. We are just beginning to use nickel-cadmium batteries in Army Aviation, and time alone can tell just how much service we will get from them. There is every reason to believe that it will be many times more than what we are now getting from the lead-acid type, especially if we furnish the necessary care and attention that the nickel-cadmium battery needs and deserves.

References: TM 11-6140-203-12
TM 11-6140-203-35
Electricity in Aircraft —F. G. Spreadbury, Macmillan Company, 1958

Operational training device at Eustis aids in field and organizational

Maintenance Training

TRAINING of Army Aviation military and civilian personnel in field and organizational maintenance for the Army's newest and largest transport helicopter began recently when the pioneer CH-47 Chinook transition course started at the Army Transportation School.

The school's first production model Chinook arrived in April from the Boeing Vertol Plant at Morton, Pa. Two monstrous operational training devices, costing $517,000, are housed in the new rotary wing building.

Sixteen students from Fort Eustis, who will be part of the corps of future maintenance instructors in the aircraft, started the first course. Basically, the course is designed to provide maintenance officers, enlisted men and Department of the Army civilians who are already qualified in helicopter maintenance with a working knowledge of the difference in maintenance for the Chinook.

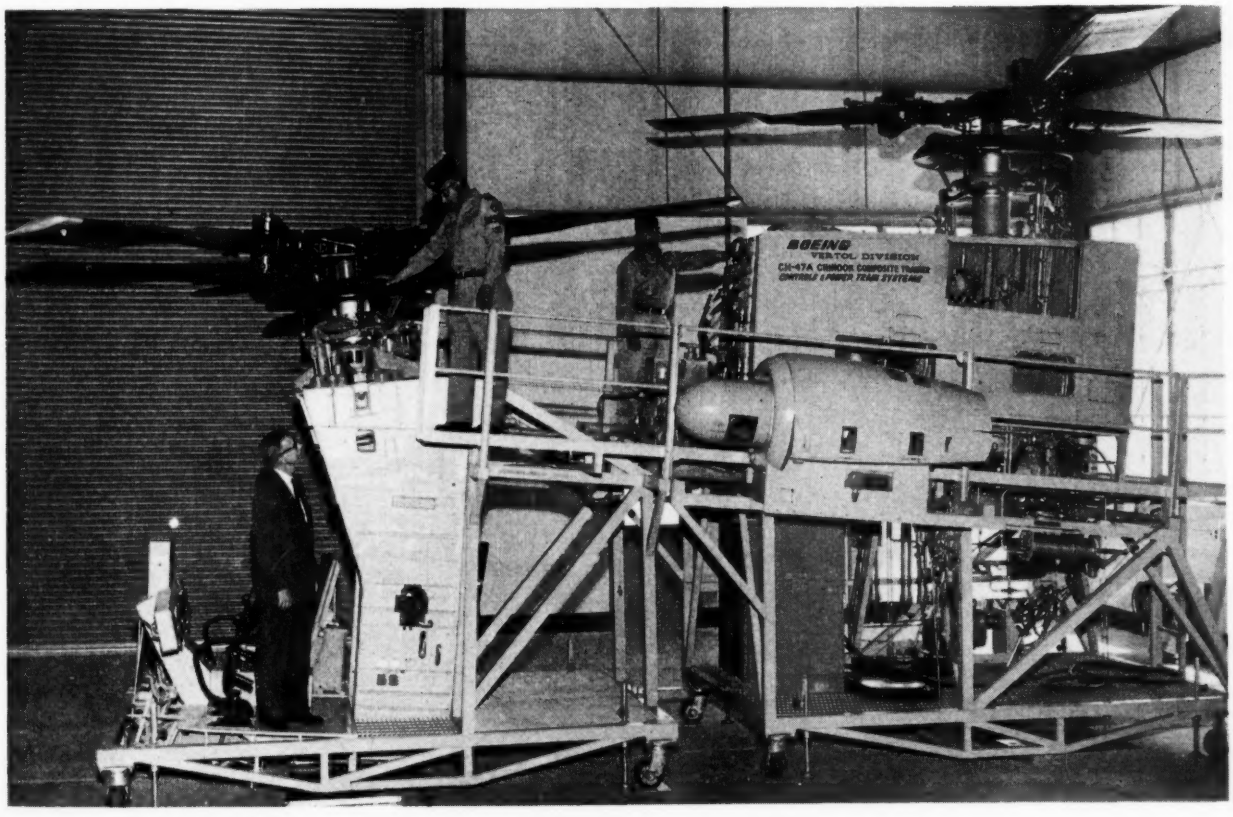
This marks the first time both organizational and field maintenance aircraft repair courses will be conducted at the school. Organizational maintenance was previously conducted at USAAVNS, Fort Rucker, Ala.

The operational training devices for conducting instruction include a gargantuan composite flight control and powertrain aid and an electrical layout. Actual aircraft components are used on these skeletal training aids to provide instructors with detailed systems.

Two other aids, one a Chinook fuel system and the other covering the hydraulic system, will further contribute to thorough and realistic instruction.

Students will receive a total of 258 hours of instruction; 190 hours will be practical mechanical work.

Checking out the giant trainer used to teach controls and powertrain systems



U. S. and South Vietnamese combine their know-how and manpower to build airstrip in communist controlled region.

THE AIRSTRIP AT RANG RANG

SSgt Bob Reid, USAF

UNDAUNTED courage, cool bravery, and sheer determination are terms often overused in war, but for a group of gritty Vietnamese combat engineers working deep in communist Viet Cong territory these descriptions seem less than adequate.

The engineers, the 301st Combat Engineer Battalion—oldest in the Vietnamese Army—have pushed an armored column (and with great difficulty, their engineering equipment) deep into the center of notorious Zone "D" in the Phuoc Binh Tan Special Military District, and are busily engaged in building a runway and repairing a bridge despite constant Viet Cong harassment.

Traveling 31 kilometers over a dirt road cut in many places by the VC, and with the road's bridges destroyed, the battalion, with scores of heavy vehicles, reached its objective at Rang Rang in two days.

Under the leadership of the battalion commander, and with

SSgt Reid is attached to the Information Office, Headquarters, MAAG, Vietnam.

their U. S. Army advisor, the engineers began in mid-April the job of hacking a runway from jungle so thick that one can see no further than a few yards into it.

Viet Cong insurgents immediately began a campaign to prevent the construction of a military base in their midst.

An estimated 20 VC snipers constantly harassed the operation from the beginning, sneaking to the edge of the strip and firing single shots then fleeing into the jungle. So far, they have killed three, wounded 10.

Before the area was adequately cleared of the communists, they infiltrated at night and placed mines along the side of the runway, causing the death of a Vietnamese ranger and an engineer.

The work stubbornly continues with the determined engineers toiling 10 hours a day, 7 days a week, in the open and under constant enemy fire. Each man—whether driving a bulldozer or wielding a hand tool—has his weapon as a constant companion close at hand.

Taking (paradoxically) hot tea in the steaming jungle command post, the battalion commander, group commander, senior Vietnamese engineer, and the American advisor talk almost casually about their enormous and almost unbelievable project.

"This will cut the Viet Cong's throat in this area," says one. "He's been entrenched in here so long that Zone D has been his greatest stronghold, and he uses it to assemble and train troops. Now, much to his distaste, a government base is going in right in the middle of his territory."

"That's right," says another,

"the VC doesn't like it a damn bit, but there's nothing he can do about it except harass. He can't move large bodies of troops through the jungle—you can't even move a squad through that foliage without scattering them—and our Ranger units providing security now have control over all the jungle trails. They're out there patrolling all the time."

An ear-shattering explosion rocks the area, followed by a column of dirt and smoke. "Relax," says the American officer, "it's not a mortar; we use dynamite to blow the trees."

The group commander twists a toe into the half-foot-thick layer of dust that covers the area and gestures toward the American officer standing a few feet away: "That is the finest American advisor I have ever seen," he says in near-perfect English. "He stays right with the Vietnamese, sleeps with them, and eats our Vietnamese rations, like fish and rice. He's always happy. All the men like him very much."

Overhearing, the advisor grins and asks, "We're having goat this Sunday, again? That goat last Sunday was delicious."

Aside, he remarks, "Goat is a special treat for Sunday meal. Each company brought three goats in here, and now we're down to one goat. The Vietnamese treat me very well, and sometimes fry me up an egg as a treat with the regular meal. I've lost a few pounds on the rice diet, but feel like a million dollars."

The group moves over to "the bridge." The bridge spans a river, about 138 feet across. No one knows who originally built it, or when. It's steel, of French Eiffel-type construction. The VC have destroyed it over a period of months, cannibalizing the steel laboriously, with hacksaws for their smelters. Now it is almost rebuilt by the 301st Engineers.

Lacking planking for the bridge, the engineers went into the jungle and have cut 4-inch diameter logs, placing them side by side for a base.

"Do you think the VC will try to hit in force?" someone asks.

"No," answers one of the advisors quickly. "Because as far as these troops are concerned, the VC aren't 10 feet tall, they're 10 inches, and they're no good. We have tremendously responsive air power that hits them quickly if they try to move, we have the firepower to stop them, and right now in here, they're confused, demoralized, and disorganized. Their defectors report very low morale in the VC camps, caused by lack of food, hardships, failure of the VC leaders to fulfill promises, and the aggressive Vietnamese Ranger operations here."

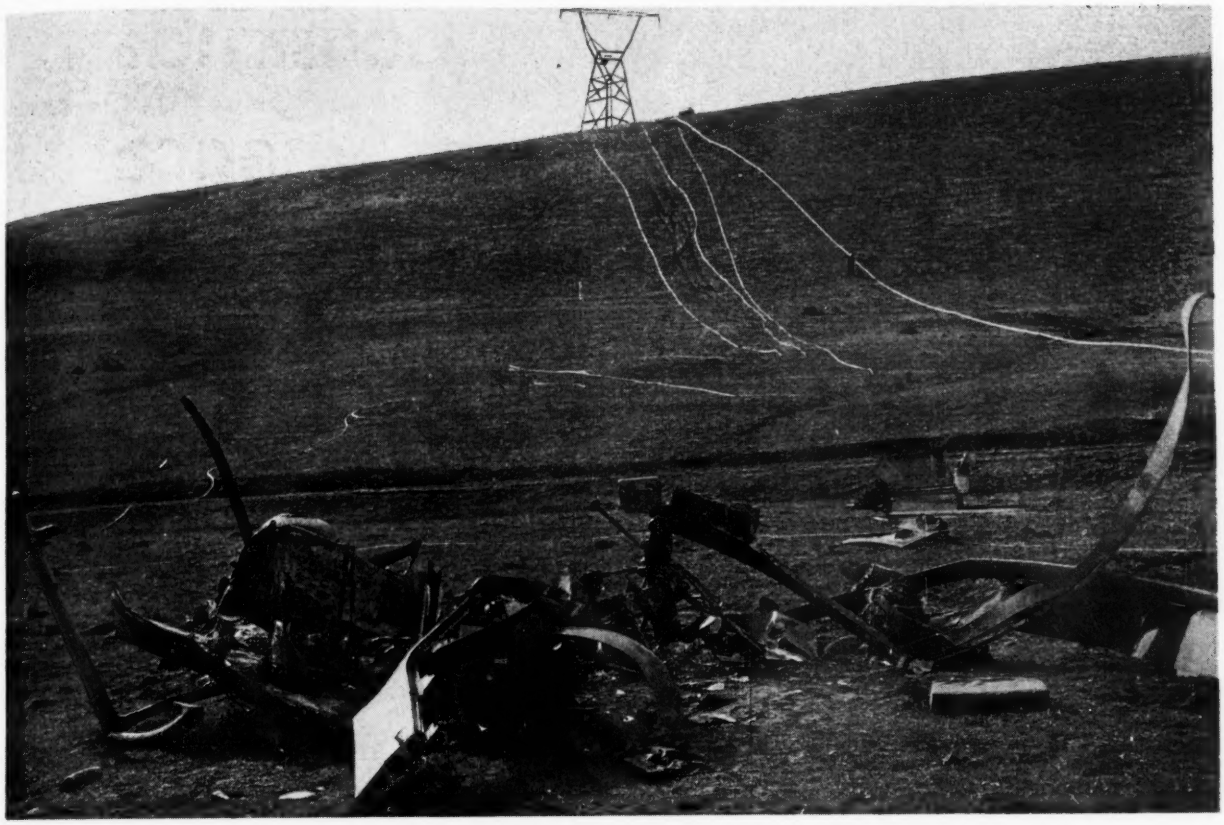
On May 2, just 23 days after the arrival of the 301st at Rang Rang, an Army Aviator eased a twin-engined Caribou onto the hard-packed strip, and Rang Rang had landed its first plane. More, including larger C-123s, were expected to follow in days.

Such is the airstrip at Rang Rang. The engineers will leave, and on their way will build another road through VC territory, to link up with a major highway.

The "Huey" (UH-1B) helicopters settle in a cloud of dust to pick up the visitors. On the way out, the pilot makes a comment to his copilot that brings the realization of guerrilla war close to mind:

"Let's slow down and wait for our escort to catch up. If we get in trouble here, we're really gonna need help fast." And the jungle, as thick as a carpet, passes below.

Your most dangerous mile is your next mile, regardless of where or when you will fly it.



Wire Strike

WIRE STRIKE accidents are on the increase and there is no clear-cut solution to this problem.

The pilot of the UH-1 in the picture above did not see the powerlines in time to avoid them, although these lines were 1.6 inches in diameter. After the wires were repaired, accident investigators flew over the same route and could not see the wires!

FY 1963 wire strike accidents include 12 aircraft destroyed, 8 major accidents, 5 minor accidents, and 20 incidents.

Although we don't have the final solution, here are some prevention tips:

Practice low flying *only* in designated areas where thorough recons have been made.

Suspect *all* areas. The open fields you fly through today may be spun into copper and steel webs tomorrow.

Poles, usually your best clues in other seasons, are frequently hidden by foliage in spring and summer.

If you see wires in a new location in your area, report them. Keep local area maps posted with up-to-date wire locations.

If in doubt—PULL UP!

Prepared by the United States Army Board for Aviation Accident Research.

Heliport Construction in Latin America

Captain Karl L. Osterloh

HELIPORT construction under field conditions is a subject little covered in printed media, even though usage of the helicopter has had extensive coverage. Yet many problems exist in building auxiliary heliports in locations where heavy equipment is inaccessible.

The difficult situations encountered in the aviation field projects of the 937th Engineer Company in supporting the Inter-American Geodetic Survey might prove interesting to those who may be faced with similar problems.

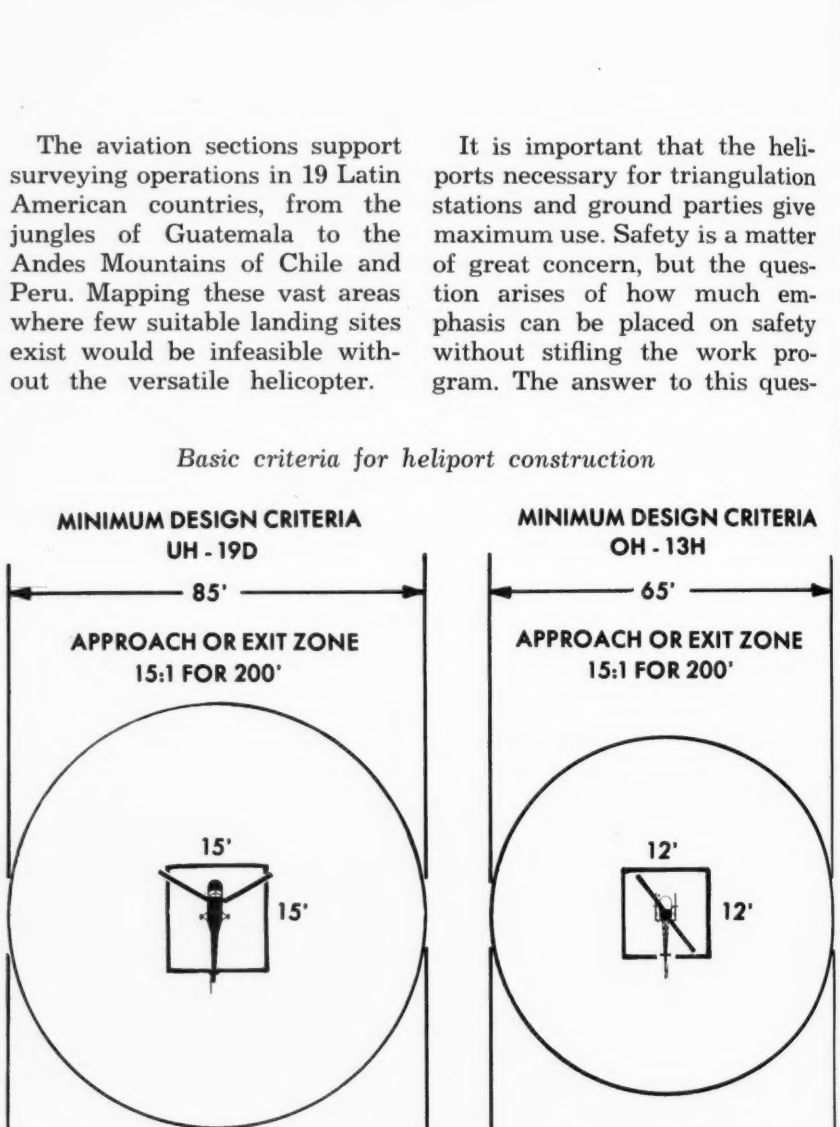
Above: Lowering man to clear heliport. Grass is 8-12 feet high.

Capt Osterloh is assigned to the 4th Engineer Bn, Fort Lewis, Wash.

The aviation sections support surveying operations in 19 Latin American countries, from the jungles of Guatemala to the Andes Mountains of Chile and Peru. Mapping these vast areas where few suitable landing sites exist would be infeasible without the versatile helicopter.

It is important that the heliports necessary for triangulation stations and ground parties give maximum use. Safety is a matter of great concern, but the question arises of how much emphasis can be placed on safety without stifling the work program. The answer to this ques-

Basic criteria for heliport construction



tion has led to the establishment of basic criteria for heliport construction (see figure).

Beyond these basic criteria, design and construction depend upon the ingenuity of field personnel. Minimum criteria often become the maximum that can be obtained with any degree of certainty.

In establishing a new base for operations, a preparation party is carried to the worksite. Often they must be lowered from the helicopter to the jungle area. Of the several tasks the preparation party must accomplish, the most important is construction of the heliport.

Often the party is quite small. It may consist of a party chief and two or more unskilled laborers. Their equipment is limited to rope, a hammer, nails, and perhaps a pick or shovel. Any other equipment necessary is usually air-dropped. Resupply depends upon helicopter support. Therefore, any bad weather or construction delays can create serious dilemmas.

Many conditions influence the exact location of the heliport. The following conditions apply to platform and ground situated heliports:

- Approach and exit zones should be straight, without turns or doglegs.
- Touchdown areas should be as level as possible. Humps and rises will cause skid-mounted helicopters to rock.
- The area must be cleared of loose debris 10-15 feet beyond the diameter of the rotor system to prevent objects from being drawn into the blades.
- Approach and exit zones must be located to permit takeoffs and landings into the wind.

Ground situated heliports are always considered first. They are the easiest to build and offer the least hazard to landing. When the terrain is extremely rocky and uneven, it may become necessary to locate a heliport in a less desirable location. If it is impossible to build on the ground, then a platform is considered.

Ground situated heliport. Once at the site, required one day to build.

Because of a lack of manpower and tools, the platform must be located as close to the source of materials as possible. In some instances, enough trees are cut preparing lines of sight to provide the required timber. When materials are scarce, a poorer site may become a compromise between materials and location.

Simplicity and sound judgment are the keys to this kind of construction. The materials and methods are a little undignified, but effective.

Whether the heliport is a platform in the midst of impenetrable jungle or a pad on a mountaintop, the best type of construction will be that which accomplishes the mission efficiently, economically, and safely. The ingenuity used in constructing suitable heliports in vastly different terrain is permitting the helicopter to play a tremendous role in accurately mapping Latin America.

Platform. Notice that the spaces between the logs are filled. This retains ground effect. Consequently, heavier gross loads can be removed from the station.

Army Aviation Support of Mapping in Guatemala

Captain Pleasant H. West

GUATEMALA is one of several countries in Central and South America being mapped by the Inter-American Geodetic Survey (IAGS). Mapping is being done by the Direccion General de Cartografia with technical assistance from the United States.

Mapping in the lowlands along the Pacific and in portions of the central section was not too difficult because of the road system. However, a considerable amount of the central area and practically all of the northern jungle area are inaccessible except by air. These are the areas where Army Aviation pays big dividends.

A few of the ways Army Aviation speeds up map production in Guatemala are mentioned below.

Reconnaissance. With helicopters and fixed-wing observation type aircraft the Field Engineer can make a personal study of a new area and definitely establish the locations of the new stations to be occupied. With these aircraft he can easily check for line-of-site between stations and eliminate the possibility of unnecessary station preparation.

Time Reduction in Transport of Personnel and Equipment. Probably one of the greatest advantages of Army Aviation is the time saved in moving equipment and personnel. It also reduces the wear and tear on men and equipment. In much of the jungle area of Guatemala a man can travel only a couple of miles a day, and it could take days, even weeks, to arrive at a new site. This possibility is elimi-

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Capt West is assigned to the 151st Engineer Gp (CBT), Fort Benning, Ga.

Bilby tower

nated when helicopters are used.

Erection of Bilby Towers. These towers enable the engineers to establish required stations in isolated areas that are too low to provide line-of-site with other stations. In one instance one UH-19 and one OH-13 transported all of the components of a 110-foot tower 15 miles in a 4-hour period. Without helicopters, moving this tower would have been virtually impossible.

Helicopters Used in Conjunction with Special Equipment. Another valuable use of the helicopter is displayed on altimeter runs, when time is of utmost importance. The versatility and mobility of helicopters also paid off in the use of the tellurometer. This piece of equipment was in demand and maximum use had to be obtained while it was in the country. By the use of helicopters many miles of accurate work were completed in a short period.

Army Aviation is used numerous other ways to provide assistance in the mapping program. A few of these are low altitude photography, emergency evacuation, rapid coverage on field classification, and station resupply.

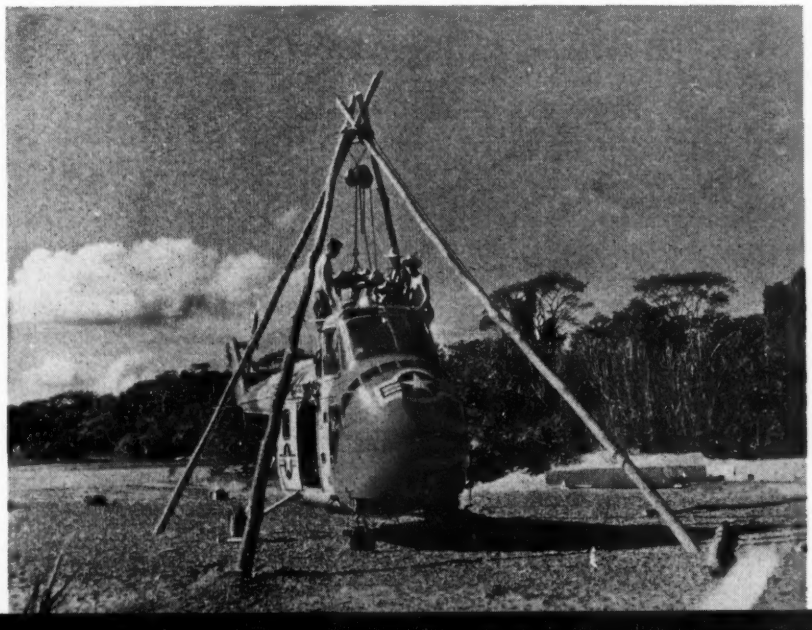
Of course Army Aviation brought problems with it when it entered the mapping work. In IAGS, heliports have to meet certain minimum standards for safety reasons. These heliports have to provide clear level ground or a level log platform 13 feet square for the OH-13 and 15 feet square for the UH-19. Also trees have to be cleared for about 80 feet around the pad to provide maneuver room. Naturally these preparations require time and manpower.

Another problem is maintenance of aircraft under adverse field conditions. Frequently crewchiefs are required to perform third and fourth echelon maintenance with only a minimum of equipment.

Transporting and dispensing aircraft fuel is another problem. Normally fuel is brought by truck in 55-gallon drums to the base of field operations and then hauled by aircraft as required to the more remote areas. Dispensing fuel by hand pumps, filtering the fuel into the aircraft, and returning the empty drums to the trucks are all time consuming.

Mapping in Guatemala still is not completed, but the end is in sight. The success of this mapping program cannot be credited solely to Army Aviation, but it certainly has played an important role. Equally important is the excellent training that Army Aviators receive while operating in support of mapping. They become highly proficient in virtually all phases of helicopter and fixed-wing operations, and will be better qualified to perform their mission in the role of support of ground troops in combat if ever required to do so.

Maintenance problems in the jungle



S-L-O-W LOW and STEEP

Major Richard L. Jones

THE FOREST RANGER gave no thought to the Army aircraft flying up the canyon at a low altitude that he had observed only minutes before. As he later recalled, the plane was considerably below the ridge and in a steep climbing turn in the direction of the canyon wall. Continued observation was cut off when the plane passed behind a mountain spur. Had the spur not blocked his view, the ranger would probably have seen the pilot lose control and the plane crash to the valley floor below.

The crash resulted in fatalities to both the pilot and passenger, and the aircraft was damaged by impact and fire. No witness actually observed the aircraft in its final plunge to earth. The last witness to observe the plane in flight was a forest ranger, just minutes before the crash.

What happened? Why did the plane crash to the ground? How did the pilot lose control? These questions among others confronted the accident investigation board.

Initial investigation revealed that the plane was an O-1E flown by a recently assigned and newly rated aviator. The mission was a training flight aimed at pilot proficiency in the local area. Mechanical failure was eliminated as a possible cause through evidence obtained at the crash scene and from study of the maintenance and historical records of the aircraft. Weather was not a cause factor, which was substantiated by weather report data. Based upon the pilot's past medical history, physiological and psychological causes were eliminated. But what about the pilot's experience and the last known conditions under which the aircraft was being operated? These factors were further studied by the accident investigation board members.

Through witnesses' statements, including the ranger's, the aircraft flight path, altitude and conduct were traced. All statements indicated a low entry altitude up the canyon until the last two observations, which revealed the plane was in a steep climbing attitude. In the last two witnesses' opinions the aircraft appeared to be dangerously low and precariously close to the canyon wall. Both witnesses had sufficient aviation experience to reasonably assure the board of the validity of their opinions.

Upon visiting the last point of observation, the board concluded that the aircraft was, when last seen, approximately 500 feet above the canyon floor. The canyon walls rose steeply at this point to elevations of approximately 5,000 feet, making continued flight in that direction impossible. The only escape from crashing into the canyon wall would be a steep left turn. A review of the aviator's records in-

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Maj Jones was a student at the University of Southern California Army Aviation Safety Course when this article was written.

dicated that he was a recently rated fixed wing aviator with only that flying experience gained at school.

Based upon the preceding information, the small concentrated wreckage pattern, and the shallow ground depression at the impact area, the board concluded that the probable cause of the accident was loss of control by the pilot when the aircraft entered into a stall/spin from a steep turn. Many other factors could be and were pointed out in the formal investigation report as contributory causes; however, the probable primary cause was none other than the old story of ignorance of or inattention to the relationship between angle of bank and stall speed.

Many of us have learned through experience. We were lucky we lived to tell the story and looked into why it happened to us and how we could prevent a repeat performance. If this young aviator had not stacked all the odds against himself and had more altitude, perhaps he would now know by experience the effect high angle of bank has on stall speed.

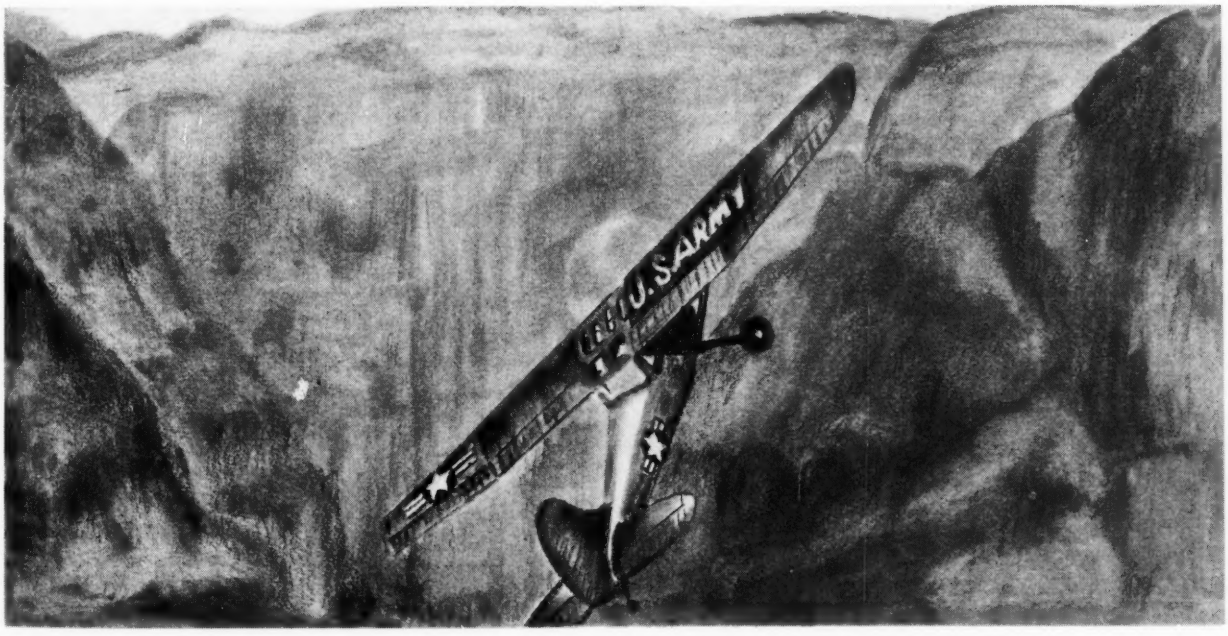
Looking into this phenomenon, we find that turning flight produces an effect on stall speed similar to the effect of weight. We all know that as we bank the aircraft the stall speed increases as the angle of bank is increased, but how much and when does it become critical? Well, not much increase in stall speed becomes apparent in bank angles of less than 30°. However, above this bank angle the increase in stall speed is rather rapid. To illustrate how these stall speeds mount as the bank angles increase, let us consider 54 mph IAS as the stall speed in straight and level flight. Then the stall speeds for each of the bank angles indicated are those shown below:

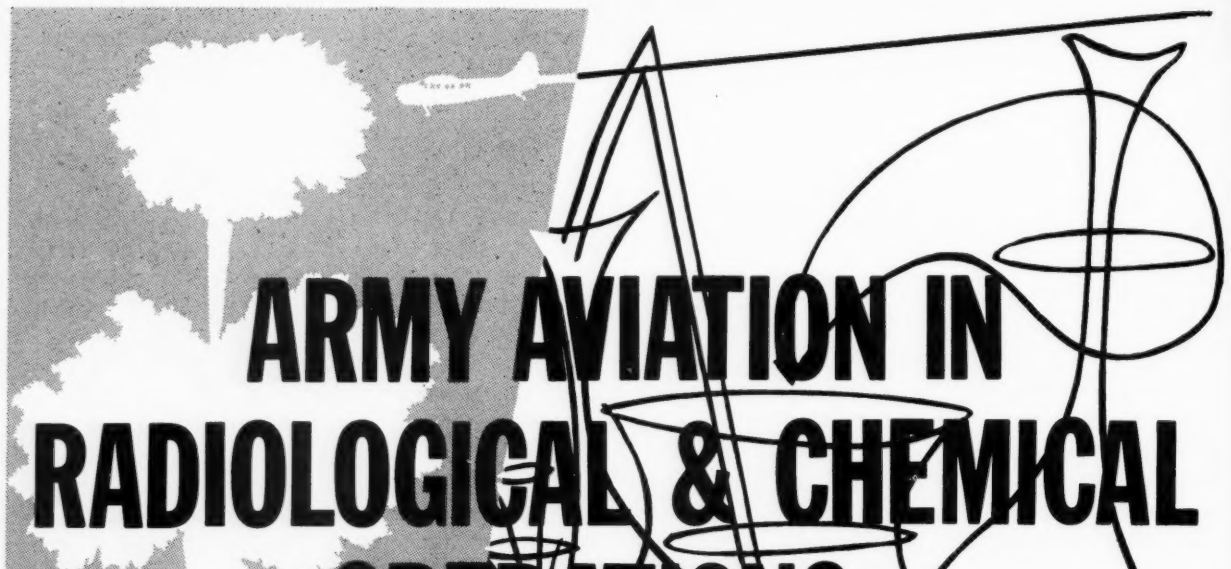
Bank Angle					
0°	15°	30°	45°	60°	75.5°
Stall Speed (mph)					
54	55	58	64	76	108

Trigonometric relationships allow determination of the effect of bank angle on stall speed and load factor (or g). The load factor, n, is the proportion between lift and the cosine of the bank angle: $n = \frac{1}{\cos \phi}$. Additionally, the stall speed in the turn can be computed through the following equation: $V_{s\phi} = V_s\sqrt{n}$, where $V_{s\phi}$ = stall speed at bank angle ϕ; V_s = stall speed for straight and level flight; and n = load factor (or g) corresponding to the bank angle.

BUT—who the heck carries all this stuff and who has the time to figure it while flying? For this reason a good rule of thumb is quoted: "30° bank is 10 percent increase; 45° bank is 20 percent increase; 60° bank is 40 percent increase and 75° bank is 100 percent increase."

Remember, the above data pertains to any aircraft at any weight. These facts emphasize the need to avoid turns at slow airspeeds—a flight condition common to stall/spin accidents, especially at low altitudes. Don't overlook the proportions.





ARMY AVIATION IN RADIOLOGICAL & CHEMICAL OPERATIONS

Captain Henry W. Meetze

Commanders are concerned with any problems that may have a bearing on the mission outcome. Any action that contributes to casualties, prevents effective use of terrain, buildings and materials, or creates time losses requires careful and diligent study. One such area of concern is discussed here.

WITH THE EVER increasing emphasis on nuclear and chemical operations, aviation personnel must be able to survive and perform assigned missions in nuclear and chemical environments. The Army Aviator must be aware of the complexities involved in operating under these adverse conditions. Aviation personnel must be familiar with both the problems and acceptable solutions.

The problems presented here are those believed to be most prevalent. The solutions are in some cases standing operating procedures; others are proposed by the author.

CHEMICAL OPERATIONS

Inherent operational problems that Army Aviation would encounter in a chemical by contaminated situation are

decontamination of the aerial vehicles,

masking and individual protection,

detection,

Capt Meetze is aide-de-camp to the commanding general, 6th U. S. Army, Presidio of San Francisco, Calif.

surveillance of contaminated areas, and

marking of contaminated areas.

If the aerial vehicle becomes contaminated while in flight, decontamination may be accomplished by aeration. The actual flying of the aircraft is the best method of aeration of the outer surfaces. Normally two hours of flight will suffice. Emergency decontamination is that which permits a crew to make a safe exit or entrance or which sufficiently reduces danger so the mission may be continued. Since it is accomplished by flying the aircraft, contamination should not interfere with the mission. In the case of GB,* contamination aeration would be sufficient to prevent danger to the crew; however, if liquid VX* were on the aircraft, aeration would not suffice and the vehicle must be washed.

Decontamination stations should, as a minimum, be placed at all unit airfields and be operated by unit personnel. When the aircraft becomes contaminated while on the ground, emergency procedure is to wash the aircraft and then move it aside for the complete decontamination required before the crew and maintenance personnel may perform their duties on the vehicle without protective clothing or masks. Information on this type of operation is contained in TM 3-220, "Chemical, Biological and Radiological Decontamination," September 1961. One problem remains, however —the standard decontaminant for GB and VX contains hydroxide. This hydroxide will cause corrosive action on aluminum surfaces and will in time render the aircraft incapable of safe flight. A safe decontaminating agent for aluminum is not now available.

PROBLEMS OF PERSONAL PROTECTION IN AIRCRAFT

The problems involved in individual protection within the aircraft are complicated. The swiftness of masking and taking immediate action depends, of course, upon detection procedures and individual training. The pilot must maintain control of his vehicle at all times. Masks, if used, would present a problem to the pilot by cutting down on pilot visibility, because the APH/5 helmet does not fit over our present masks. Protective suits would be cumbersome and uncomfortable, and would not give the pilot freedom of movement within the cockpit. A lightweight, inexpensive system of cockpit pressurization would be a more feasible solution to this problem. A second solution would be a special mask designed to snap or fit snugly on the helmet.

Present ground detection kits are impracticable for use in the aircraft. Time involved in using these kits makes it imperative that a type detection system be designed for aircraft usage. An example of this would be a collector/adapter mounted on the outside of the vehicle which samples and tests the surrounding atmosphere and gives off a visual alarm if a chemical agent is present.

Surveillance of contaminated areas should be made from the aerial vehicle. Each aircraft should be equipped to pick up immediately the presence of either a nonpersistent or persistent agent. In addition, the crews should have the ability to monitor and mark areas contaminated with a persistent agent. This marking of areas could be done easily by dropping colored flags/markers and by the use of long burning smoke pots.

RADIOLOGICAL OPERATIONS

The problems of operation in radiologically and chemically contaminated areas are similar in some instances. In most cases the solutions are completely different. Problems that Army Aviators would encounter in a radiological operation are

protection from dazzle,

accumulated dosage,

maintenance,

decontamination,

detection,

surveillance of contaminated areas, and

marking of contaminated areas.

The problem of dazzle is one that cannot be overcome easily, because the pilot must have unobstructed, clear visibility throughout his flight. Yet, he must be protected from a surprise detonation and the brilliant light that would render him totally incapable of flying the aircraft. Friendly nuclear blasts present no difficulty if proper SOPs are practiced in warning friendly aircraft. In case of an enemy blast, the pilot would be caught totally by surprise; and the chances are minimal that he will be turned or positioned so the flash from the blast will not blind him.

In all future flights where known or suspected chemical or radiological activity is taking place, pilot and copilot/observer/monitor should be in the cockpit. The copilot/monitor/observer could wear dark glasses so he could take over the aircraft in the event the pilot is disabled. Another solution might be the use of a dark colored polarized canopy.

The problem of accumulated dosage is probably the most se-

* Chemical agents

rious the crew would encounter in a radiological operation. The present pocket dosimeter is inadequate for the pilot because he must divert his attention from control of the aircraft for readings. An accumulator to measure total dosage received could be installed on the aircraft as On Equipment Materiel. This equipment would remain with the aircraft at all times and would present a quick, accurate indication of radiation accumulated.

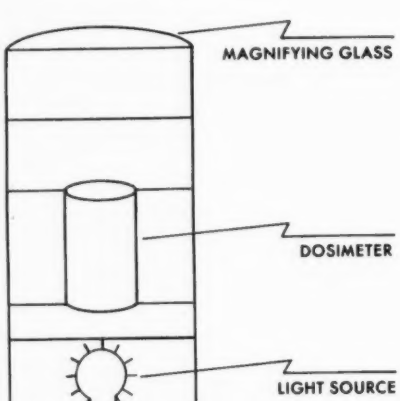
CHECKING FOR RADIATION LEVEL

The amount of radiation accumulated by the aircraft will not be a problem unless the aircraft flies through a nuclear cloud. In this instance small atomic-sized particles will cling to the outer surface of the aircraft and may cause a dangerously high radiation level.

Concerning crewmember exposure to radiation, Mr. Norris Sills, Deputy Chief CBR Materiel Office, U. S. Army Munitions Command, made the following comments:

"A dosage device in the cockpit requires proper use and certain record keeping by those personnel involved. If a crewmember has a certain reading on his dosimeter when he gets aboard, he must keep this in mind and add that to what the OEM device aboard the aircraft shows in order to know when to discontinue the mission or accept the consequences.

"It would be simple to preset an accumulation dosage to the OEM equipment that corresponds to that on the pilot's dosimeter. However, if there were another crewman, his dosimeter would probably not read the same as the pilot's. In such cases, the dosimeter with the highest reading could be used as the control and this value preset into the OEM equipment. This then would represent the safety limit for the most vulnerable member of the crew.



Pocket dosimeter

"The pocket dosimeter could be utilized by installing a simple device on the instrument panel consisting of a light source and a magnifying glass combination into which the self-indicating pocket dosimeter could be inserted on boarding the aircraft. Magnifying lens would make it easy to read at a glance. This would not take up a lot of room and would not necessitate an OEM instrument. However, if there is ample room, the OEM device is preferred."

Mr. Sills further stated: "Accurate records and close surveillance of pilots and crews (including ground crews) must be carefully maintained in order to determine 'radiation status.' As their 'radiation status' reaches the 'critical' point (from a predetermined value set by medics and commanders), backup crews should be available to man each aircraft."

DECONTAMINATION OF RADIOACTIVE EQUIPMENT

The two sources of radioactive contamination are radioactive fallout, which is the main source of radioactive contamination on the battlefield, and induced radiation.

If aircraft become radioactive as a result of fallout, they may be decontaminated by three methods: *

- Removal, which involves the removal of the contaminated dust from the equipment.
- Sealing, which is the covering and sealing of the radioactive contamination with some type of material that will act as a shield to prevent escape of nuclear radiation; this refers only to alpha and beta contamination.
- Aging, which will depend upon the decay rate and the amount of radioactive contaminate.[1]

When speed of decontamination is the most important factor, brushing should be performed first. If brushing proves ineffective, washing should be performed. If both prove ineffective, aging should be used. When speed is not an important factor, aging is the most desirable method. Equipment that becomes radioactive by induced radiation can be decontaminated only in this manner.[2]

Decontamination equipment, such as brooms and a high-pressure water system, should be available at all or selected heliports and airfields; and aviation personnel should be trained in decontamination methods.

RADIOACTIVE DETECTION

Detection devices could be used either inside or outside the cockpit. The IM 108/PD, the same instrument which is used by the foot soldier, or its replacement, the IM 174/PD, may be placed in the cockpit. Both are capable of taking radiation

readings from the interior. Surveillance of contaminated areas should be made from within the aircraft if possible. This could be done by a remote control monitoring device that is lowered, read, and raised by automatic controls within the cockpit. Readings should not be taken while hovering; the dust cloud caused by the helicopter may create a false reading directly beneath the aircraft.

An aerial survey made over a large area (such as corps and army rear) cannot be effectively accomplished with the helicopter or slow moving fixed wing. A faster aircraft coupled with an electronic device that will continually indicate air readings corrected to ground level is desired.

Fixed wing could be fitted with a radar altimeter for recording absolute altitude. This altimeter can be coupled into a recording rate meter to compensate automatically for the height of the aircraft and thus give the gamma radiation intensity on the ground. A Doppler navigation system will pinpoint the exact location of the aircraft. This method can give a quick and accurate plot of fallout patterns.[3]

The problem of marking radioactive contaminated areas, as in marking chemical areas, could be accomplished by the use of long burning smoke pots and by dropping colored flags/markers.

It is essential that Army Aviators be equipped with the proper knowledge and material to carry on operations in all types of warfare, whether sophisticated weapons or others are involved. Our aviators and crews need proper training to be able to live and fight in a chemical or radiological environment. The chance, however slight, that we may find ourselves engaged in these environments is still present. We must be prepared.

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* Any one, or a combination of the three methods described here.

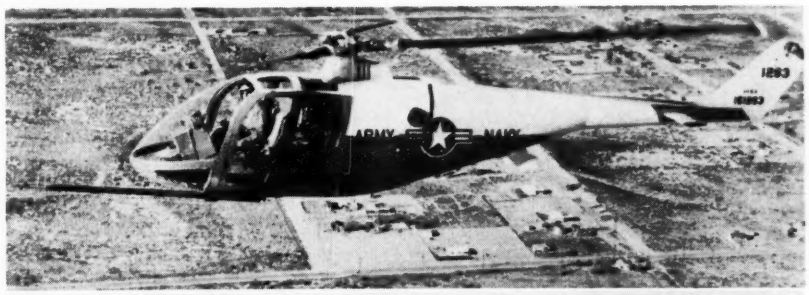
1. Sect. II, Chapter 4, TM 3-220, Sep 1961.
2. Ibid.
3. At present there are two special purpose meters for high performance aerial survey. The AN/ADR-6(XE-1) is a high-performance aerial scintillation survey set which has a sensitivity of 0.1 to 1,000 rads per hour at 500 feet altitude. It includes a manual altitude correction device and telemetry set. It is being researched by USA-SRDL and Franklin Systems.

   The other, the AN/ADR-6(XE-2), is an alternate approach to high performance aerial survey and is presently in the study phase. Technical requirements are similar to the meter listed above, except altitude correction will be automatic by means of radar altimeter. It is being researched by the Nuclear Corporation of America.

XH-51 Features 3 Blades, Rigid Rotor, Turbine Engine

Sporting a slim silhouette and retractable skis, the Lockheed-California Company's XH-51A rigid rotor helicopter is designed to fly up to 200 miles per hour. It already has flown 160 mph. Being developed under a joint Army-Navy contract, the aircraft incorporates a three-bladed rotor system 35 feet in diameter. It is powered by a Pratt & Whitney PT6 free turbine engine rated at 500 maximum takeoff horsepower.

The XH-51A has an overall length of 31 feet which extends to 41 feet when the rotor is operating. It has an empty weight of 2,130 pounds and a design gross weight of 3,500 pounds. A payload of 600 pounds is provided, excluding the pilot and carrying 530 pounds of usable fuel. The cabin contains two side-by-side seats with dual controls and adequate space behind the seats for flight test instrumentation.



Let's Get With It

Colonel Robert M. Hamilton
Director, USABAAR

IT'S TIME to take a hard and realistic view of our accident cause factors. Everybody agrees that accidents should be prevented but few are willing to face the consequences implied in the findings of thorough accident investigations. At the command level we seldom find reasons for self-contentment in the accident analysis of a competent investigation team. In many cases our pride is hurt and we tend to spend more effort finding extenuating circumstances than converting the obvious implications into system-improving measures.

According to the book, an aircraft accident is an "unplanned event." However, an analysis of accident reports on file at USABAAR closely supports the definition that it is a "manifestation of failure." Accidents, of course, are a waste, but they become a complete waste only when we fail to discover, *or refuse to recognize,* the underlying failures that prompt them. Although the well-known term "pilot error" rivals only sex in popularity, it is a meaningless term because it refers to an effect rather than a cause factor. These factors deserve our close and unbiased scrutiny if they are to be isolated and eliminated.

The following analysis of a recent CV-2 accident is an excellent example, showing that certain pilot error-inducing factors are inherent in our system.

The accident: A Caribou crashed and burned during a short field strip landing attempt. The aircraft veered from the strip, travelled across about 600 feet of open terrain, and crashed into a group of trees. Four crew members and eight passengers exited through the main cargo door, uninjured. A small fire spread and the aircraft was destroyed.

From the pilot's viewpoint: The landing was made on a 2,000-foot strip, sunk about 2-4 feet below the adjacent terrain; there was a 6-8 knot quartering headwind from the right. A touchdown point was selected 350 feet down the runway. Gross weight was estimated at 25,000 pounds. A 50-foot high tree at the beginning of the runway was selected as the go-around point. While aligned with the runway and abreast of the "go-around" tree, the pilot felt a slight sink and noticed that the aircraft was drifting to the left. At this time he had 40° of flaps and about 60 knots IAS. He lowered the right wing in an effort to stop the drift and started his roundout at about the same time. As the aircraft moved back over the strip he tried to raise the right wing with aileron and the addition of power. Aileron pressure to lift the right wing was ineffective and the aircraft slid to the right and the right main gear contacted the ground. He believed that "the power got hold" at this time and that he closed the throttle after the aircraft had left the strip. He did not intend to go around but used power, about 75 percent, only to control the touchdown after he felt the light intensity stick shaker.

Copilot's views: According to the copilot the last time he checked the airspeed it was 54-56 knots and the stick shaker was on. He thought the pilot applied full left rudder at this time. Power was applied before the right wheel touched down. After initial ground contact the aircraft became airborne again and he felt "relaxed" because he thought a go-around was initiated. Throttles were pulled back, however, while the aircraft was off the ground.

Crew training: The pilot had completed his C phase of training 6 months to the day before the accident. It had been 4½ months since he had graduated from the CV-2B course. He had a total of 485 hours of which 257 were single engine and 228 in the Caribou. Of this 228, he had flown 102 as a copilot, 122 as first pilot, and four as instructor pilot after completing the Caribou MOI, one week before the accident.

The copilot had completed the CV-2B course almost three months before the accident. He graduated from C phase a month later than the pilot. His total flight experience was 436 hours, of which 273 were single engine and the remaining 163 in the Caribou. Of this he had flown as

first pilot for 93 and as copilot for 70 hours.

Of particular interest is the fact that the pilot and copilot did not solo the Bird Dog until they had flown 16 and 21 hours respectively.

Firefighting equipment: A fire started in a severed portion of the right wing and the remaining right wing section as the aircraft struck several trees before coming to rest. Most eyewitnesses agreed that standard firefighting equipment could have controlled the fire at this point. Unfortunately, none was available. The fire and fuel leaking from the right wing set fire to the grass and spread under the aircraft to the fuel dripping from the left wing. It took approximately 30 minutes before the main fuselage started to burn and 45 minutes before the first firefighting equipment arrived. Except for the two engines, the aircraft was completely destroyed by fire.

The landing strip: The strip on which the pilot attempted to land had its hazards. It did not meet minimum requirements in TM 5-251 (Army Airfields and Helipads, February 1958) for cleared area width (150 feet); the base of a tree at the approach end of the runway was less than 60 feet from the center of the runway. Although the runway width of 33 feet exceeds the minimum requirements in TM 5-251 by 8 feet, it is obvious that this regulation does not allow for the use of aircraft such as the Caribou, which has a wheel span of about 25 feet, 9 inches.

It should also be noted that there was no operational necessity to use this strip, since a better strip was available less than 2 miles away. Actually, the latter strip was normally used for the unit's Caribou operations, although there was no clear-cut operations policy.

Some helicopters parked alongside the runway reduced the effective runway length by about 700 feet. In conjunction with the earlier mentioned factors, this made a landing on this strip a critical undertaking, even for an experienced pilot.

Discussion: It is probably correct to state that the pilot showed poor judgment, not only in selecting this strip, but also in continuing an approach and landing under circumstances that made a successful landing highly improbable.

Whom or what are we going to blame, if blame is required? The pilot's inexperience?

Certainly, the only cure for inexperience is experience, and the only way to gain flying experience is to fly. But realistic planning and operational assignments must take the experience level into consideration.

Commercial airlines maintain rigid training and experience standards for aircrew personnel. Copilots fly for years and build up thousands of hours before they are trusted with the responsibility of flying passengers. Yet a Caribou pilot is given the responsibility of 30 or more lives with a bare fraction of this training. We should realize that the flying of the Caribou is comparable to the job of a DC-3, Martin 404, or F-27 captain. Actually, the Caribou pilots operate under more adverse conditions in many ways. The fact that our casual approach has not yet resulted in more dramatic mishaps is probably due to the excellent flying characteristics and crash safety features of the Caribou. It would be foolish to assume, however, that we can rely on these favorable factors alone.

Our standards must be flexible, but if we are to prevent accidents in which inexperience plays a causative role, we must assign our more experienced pilots to our more complex equipment. Let's give our new people a chance to gain mature flying judgment before we load them down with the responsibility of flying large aircraft with many passengers. Let's team them with experienced personnel until they wear the shine off their wings.

This accident is one of the many that points a critical finger at some of our basic policies. Correct these and our total mission capability as well as our accident rate will improve. Accident prevention, not investigation, is the real measure of success and this we can achieve if we are willing to "get with it."

NEVER AGAIN

FLYING WEST from Seattle over the waters of the Puget Sound area, I found an opening in the heavy overcast and climbed to 11,500 feet. Mt. Rainier was to my right. With a tailwind of 35 knots, I soon passed over the Cascade Mountain Range. The overcast below was dissipating into a scattered cloud condition so I descended to a lower altitude.

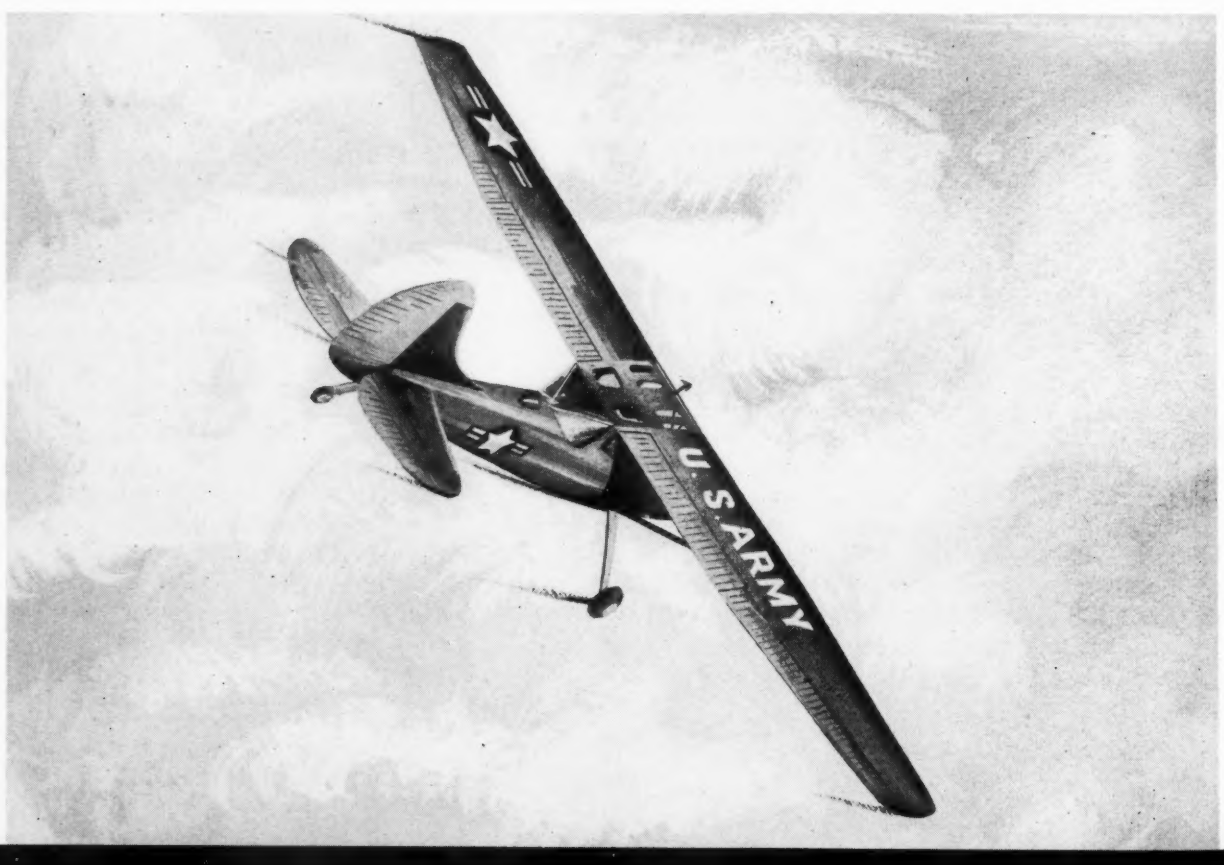
At the weather briefing and flight clearance that Saturday morning at the Naval Air Station in Seattle, Wash., there seemed to be some doubt by the Navy people at the ability of my TO-1D to negotiate the flight to Helena, Mont. Despite their doubt, I accepted a VFR on-top flight clearance. The top of the moderate to severe icing cloud layer was reported at 10,500 feet.

At the lower altitude, with a feeling of well-being, I ate a sandwich and lit my usual after dinner cigar. But as I approached Spokane, I had to return to 11,500 feet to maintain VFR. I reported my position over Spokane radio and requested present en route weather.

The weather picture below was IFR with moderate to severe icing in the clouds, so my present altitude was the logical choice. As I approached Mullen Pass Radio it was necessary to climb to 13,500 feet.

I realized this was too high

This account was furnished by a member of the Communicative Skills class of the Army Aviation Safety Course, University of Southern California.



to fly without oxygen, but the flying was smooth and my groundspeed was 145 knots. My estimated time en route to Missoula, where I planned to refuel and check the weather, was only 40 minutes.

But as I flew, it was necessary to hold a slight angle of climb. I soon passed through 15,000 feet. I knew I was getting into the danger zone, so I relaxed my entire body the best I could by moving the seat as far back as possible and limiting my physical activity solely to control of the aircraft. I soon reached my maximum altitude of 16,500 feet and leveled off above the overcast. I was well aware that I had the choice of returning to a lower altitude.

But the choice held with it icing conditions and mountain ranges that reached upward to 10,000 feet. So I elected to stay at the higher altitude. At frequent intervals I looked at my fingernails and checked my breathing and vision. I felt I could still descend to a lower level if it became absolutely necessary.

Soon the signal came through my earphones indicating my position over Alberton Fan Marker, 20 miles from Missoula. I immediately called Missoula and requested an omni instrument approach.

I realized it was necessary to remain as calm and inactive as possible. Any excitement or rapid movement would demand more oxygen. The instrument letdown would take me from 16,500 feet to a reported ceiling of 4,500 feet.

Missoula has a very tight approach pattern between high mountain peaks. Having received my approach clearance just before passing over the omni, I then informed Missoula Radio that I would fly 5 minutes beyond the station, make a 180° turn on top, and then start my descent. I didn't want to have to descend more than 1,200 feet per minute and I wanted to limit the need for banking and turning in my questionable condition while on instruments. With this approach, I would pass over the omni station outbound at 10,000 feet for my only turn, the procedure turn, in the letdown pattern.

After locking on my instruments and checking gyros, I made my final visual 180° turn and started down. The aircraft plunged into the dark gray overcast.

At about 10,000 feet, the high cone station passage sounded through my earphones and the light gave a blinking nod. I still had two things on my mind—the procedure turn within those mountain peaks and getting rid of that altitude! I scanned the instruments carefully, maintaining a 1,000 fpm descent rate and 90 knots airspeed. At the calculated time, I started the procedure turn with a standard rate bank.

I took my eyes from the instruments to check for icing and saw it forming on the wings and struts. Just two more minutes should put me in the clear. As I reached 5,000 feet, still on the gauges, a feeling of anxiety engulfed me. Would I break out before reaching minimums or would I have to climb back through all that cloud? Would the aircraft climb with all the ice I was picking up?

At 4,500 feet a dim view of the ground came into view and the airport loomed in front of me. Within minutes, the wheels touched the runway.

As I taxied in, I looked up into that gray overcast and made a firm resolution—never again!

100 Percent!

FORT WAINWRIGHT'S 65th Transportation Company (Lt Hel) recently joined forces with the Federal Aviation Agency to qualify all 26 helicopter pilots for commercial pilot ratings.

After informal instruction by the unit instrument examiner and the instructor pilot, the 65th invited an FAA examiner to Wainwright to administer the written test.

Based upon Civil Air Regulations, the examination consists of 50 questions designed to thoroughly test the aviators' knowledge of regulations governing the operation of civilian commercial helicopters.

In addition to all pilots of the 65th, the unit's primary supporting organization, the 18th Detachment (CHFM), also qualified its pilots for commercial ratings.

Flight requirements for the commercial license were met through graduation from the U. S. Army Aviation School and experience in field units during the pilots' careers. Military records substantiating the flight experience and proficiency are maintained by all aviation units.

The Shawnee Braves may be the only 100 percent commercially qualified helicopter company in Army Aviation.

inflight emergencies in all-weather choppers . . .

Leave It Or Ride It?

Captain Lloyd G. Gardner

Capt Gardner is a member of the Operations and Training Section of the Analysis and Research Division of USABAAR.

SUDDEN QUIET knifed into the cockpit. Engine failure! Down went the pitch—rotor rpm in the green—hold the airspeed—check the instruments—try for a restart.

The helicopter had just reached its assigned altitude of 6,000 feet. Outside, smooth gray stratus cloud whipped by. While the pilot went through his emergency procedures, the copilot broadcast their approximate position.

Trying vainly to restart the dead engine, the pilot watched the altimeter hands unwind through 5,000 feet. He thought of the weather report they'd heard a few moments before—ceiling, 100 feet; visibility, one-half mile in fog. Give it one more try!

Four thousand feet. No response. "Bail out!" shouted the pilot, reaching for his emergency window release. He watched the copilot jettison his window, jerk his safety belt open, tug his helmet cord loose, and dive overboard. Without hesitation, the pilot trimmed to hold rotor rpm and airspeed and followed.

Waiting until he was well clear, he yanked the D ring and held his breath until he felt the solid tug of the blossoming canopy. He

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strained to see downward through the gray mist. Slowly, the gray turned to green and he saw the white parachute of the copilot silhouetted against the treetops. "So far, so good," he mused. "Now, all I have to do is concentrate on making a good landing."

Fantasy? Not to the present day Army Aviator! No longer are helicopters restricted to VFR conditions and low altitudes. Instrument flights and altitudes are with us now, and it's a safe bet this added versatility will be used more and more in the days to come.

But why bail out? What if trees are below? Why can't you decelerate when you spot the trees and ease down with pitch? Wouldn't that be better than taking a chance on getting your chute fouled in the rotor? Sure, we know paratroopers frequently jump from choppers, but the engine's running and the pilot has a firm grip on the cyclic—that's different! They don't have to worry about their chutes getting fouled. And the aircraft won't roll over on top of them!

This brings us to the question that's been asked many times. If YOU were on top or in the soup and YOU were suddenly faced with an emergency, would YOU bail out? Would your answer be the same if you were sure the chute wouldn't foul and the chopper wouldn't roll over on you?

To date, nine persons faced with this situation bailed out—and eight lived to tell about it! The one fatality came from an unopened chute and the passenger wearing it apparently didn't know how to pull the ripcord (claw marks were found on the harness above the D ring).

These people bailed out at altitudes ranging from 800 to 9,000 feet. That's right—*800 feet!* One made a delayed jump from 1,500 feet. His chute blossomed at approximately 150 feet, which means he probably pulled the cord at about 300 feet. (Airborne personnel tell us it takes approximately 200 feet for a back pack to open.)

Why did these people jump? In one case a main rotor blade separated from the rotor head. In another, the cyclic control jammed. The whole rotor head separated in still another, and in one the main rotor blade severed the tail rotor drive.

Convinced yet?

If not, consider that helicopters have been known to burn in less than three minutes. How long would it take you to land from 6,000 feet? And how long would it take you to escape from the wreckage if you were pinned in or injured?

As for clearing the rotor systems during autorotation flight, the vertical terminal velocity of the human body at sea level is approximately 120 miles per hour, or 10,560 feet per minute. The vertical velocity of an autorotating helicopter is 2,000-3,000 feet per minute. This assures vertical separation.

Horizontal deceleration of the body depends on the velocity of the aircraft and the attitude of the body in regards to the relative airflow. A body departing the aircraft head first into the airflow will meet with less drag than one facing upright into it. The rate of horizontal separation will vary from zero in the case of a vertical autorotation to the maximum at the fastest attainable autorotative airspeed. Since vertical separation can be considered a constant factor, the most favorable condition for bailout is the highest airspeed.

In flight helicopter emergencies during FY 1963 included 191 engine failures, 16 control malfunctions, 2 main rotor blade failures, 9 transmission failures, and 2 tail rotor blade failures. These accounted for 34 major accidents, 14 fatalities, and injuries to 54 persons.

While these happened in VFR conditions, the handwriting is on the wall. More and more helicopter pilots are becoming instrument qualified and more and more helicopter weather flights are being made.

Now is the time to ask yourself . . .

LEAVE IT OR RIDE IT?

USABAAR would like to have a description of your experience or your comments about helicopter bailouts.

Please address: Director, USABAAR, Fort Rucker, Alabama. Direct communication authorized by AR 15-76.

WELL DONE

AIR TRAFFIC control in a high density traffic area is complicated enough. Compound it with bad weather and an aircraft which has lost its radios, and things can get frantic.

Quick thinking on the part of two Army Aviators recently averted just such a situation.

Captains Leonard T. Brown, pilot, and Edward R. Shore, Jr., copilot, assigned to Flight Operations Division, United States Army Aviation Test Board, Fort Rucker, Ala., departed Cairns Army Airfield in U-6A with two passengers for Atlanta Municipal Airport.

Standing in front of a Beaver, Captains Brown and Shore discuss their "GCA"

Cairns weather was reporting 300 overcast, 1 mile. Atlanta forecast for ETA was 300 scattered, 400 broken, 1,500 overcast, and 2 mile visibility in light rain. After takeoff, the crew switched the air-ground radio to Cairns departure radar and lost all UHF voice communications.

Efforts to re-establish contact proved futile. Climb was continued according to clearance and assigned altitude. Upon reaching VFR conditions above the clouds the two pilots realized that continuing to destination would greatly increase the workload on controllers in the Atlanta area.

They determined to find a way of obtaining clearance back to Cairns. Air-to-ground voice contact was made with Signal Corps Activity Control on FM frequency. The SCAC operator initiated a telephone patch between the aircraft and Cairns GCA. A successful ground control approach was completed. Weather at the time was 500 overcast and 1 mile visibility. To all concerned, Well Done!

dress to live

James E. Coleman

ARE ARMY AVIATORS becoming more aware of the value of proper flight clothing?

Take a closer look at your fellow pilots and judge for yourself. You will see that the latest flight line fashion still includes (1) an occasional hotrock wearing half-Wellington boots, (2) the manly type who unzips his flight suit to expose a hairy chest, or (3) the barehanded character who thinks gloves are only for winter flying.

But, in all fairness, you won't see as many of these types as you used to. Two reasons: more equipment is available than ever before and the APH-5 helmet has gained an excellent reputation for preventing broken headbones.

After accepting the hardhat on its merits, most aviators adopted a more professional outlook in regard to their flight clothing. They discarded their Wellingtons and low-quarter shoes for proper flight boots, and some started wearing gloves to complete the ensemble. Gloves were usually scrounged Air Force, Navy, or self-purchased types in preference to the bulky, loose-fitting Army issue.

Even though aviators are dressing better, many still refuse to get into the movement. Among these, unfortunately, are some of our older aviators who are guilty of setting poor examples for the youngsters. For comfort's sake—and mostly because their earlier training didn't require it—they often are seen sans gloves, and wearing improper footgear and rolled-up sleeves. Strangely enough, some of the worst offenders are instructor pilots—a select group whom our fledgling aviators highly revere and strive to imitate in every way. Worst of all, the habits an impressionable student picks up from his instructor are likely to remain with him throughout his flying career. More IPs and senior aviators would wear proper flight clothing if they realized that this encouraged others to use the initiative and judgment to do the same.

Let's choose an actual case from the records and evaluate for ourselves the value of proper

dress. For purposes of anonymity we'll refer to the pilot as Captain Saavskin who survived a fiery helicopter crash and lived to tell about it.

During a pinnacle approach at a density altitude of 6,000 feet, Captain Saavskin's helicopter settled with power and failed to reach its intended landing spot. He fought for control but the aircraft struck the rocky terrain, tumbled down a steep, stump-covered hillside and finally came to rest in a grassy ravine.

"As the helicopter came to rest," Saavskin recalled, "gasoline was spilling over me. I looked and saw one opening . . . the same time fire entered the cockpit." (Observers said a loud explosion occurred about this time.)

"I departed as rapidly as possible," said Captain Saavskin, "and extinguished my burning clothing by rolling in the tall grass."

Two companions who had been watching from a nearby knoll rushed downhill and led him away from the helicopter, which exploded a second time. He was then flown to a hospital for treatment.

Here are some interesting facts reported by the flight surgeon: "Helmet came off during the exit and pilot received bruises and scratches of the head while rolling down the steep, rocky hill. Additional injuries included second (and some third) degree burns of the face, forearms, lower legs, and inner thighs. Flight suit, gloves, boots and helmet prevented more extensive or severe burns, even though the pilot states he was drenched in gasoline when the fire started. The flight suit (international orange) did not burn and the only evidence that it had been exposed to fire was scorched areas on thighs and right elbow. Body burns occurred on the exposed face, around leg and arm cuffs, and wherever the flight suit had been torn (thigh and right arm). *The largest area of burns was on the right forearm where the flight suit had been partially rolled up.*

"Pilot states he does not remember taking the helmet off and that he remembers receiving a hard blow on the head during the crash . . . the helmet probably came off after the aircraft came to rest in an inverted position but prior to his escape.

"In view of extensive damage to the helicopter and exposure of the pilot to fire after being soaked in gasoline, the outcome is excellent testimony to the protective equipment, including seat belt, shoulder harness, gloves, boots, flight suit, and helmet."

After a serious accident three years earlier in which an aviator and crewchief sustained serious burns, especially of the hands and feet, Captain Saavskin's unit took immediate action to establish the wearing of a proper flight uniform. This consisted of a flight suit, APH-5 helmet, gloves, knife, and combat boots. Like insurance, the policy paid dividends. The fact that Captain Saavskin is back on flight status is proof enough of the value of protective clothing even though he was drenched in gasoline.

Question: Judging by *your* flight dress habits, if this had been *you* instead of Captain Saavskin, *how would you have fared?* Better or worse?

If you are uncertain as to what to wear or when to wear it, drop in for a visit with your friendly flight surgeon. He knows the answers and will be glad to help you.

Going to School? Don't Forget Your Records!

NUMEROUS instances have occurred of enlisted personnel reporting to Fort Rucker for school training without their personnel records. AR 611-215, section 4, paragraph 17, requires the personnel records of individuals reporting to a school for training to be surveyed to ensure "the input of qualified personnel to school courses and to preclude unnecessary training of individuals already qualified in skills and knowledges in which the course trains."

Section 3, paragraph 11e, states, "The personnel records jacket will accompany enlisted personnel to schools as prescribed in AR 640-10."

The failure of enlisted personnel to have their personnel records in their possession when reporting for school could cause unnecessary delay in processing, placement of individual in a holdover status pending clarification of areas of contention, or, in limited cases, return of individual to his unit without training.

Commanders and personnel officers must make every effort to comply with the provisions of AR 611-215 to ensure expeditious processing and training of their enlisted personnel.

HIDDEN ANGER

crash sense

PREPARED BY THE U. S. ARMY BOARD FOR AVIATION ACCIDENT RESEARCH

THANKS to the efforts of another anonymous flight surgeon, CRASH SENSE is able to bring you the detailed background information so important in answering the elusive *why?* in an otherwise unexplained accident. The why in this case arose when an experienced (approximately 2,000 flying hours) aviator did not go into autorotation after his engine failed.

What caused the engine to fail and the fix have been published elsewhere and will not appear in this account. Nor will the type of aircraft, names, dates, or places. This will be a completely anonymous description, published solely in the interest of accident prevention.

Cause factors listed by the investigation board were:

Engine failure

Failure to reduce collective pitch to minimum when engine failed

Increased collective pitch approximately 200 feet above the ground

Judgment

Fatigue

Worry

Emotional upset

* * *

Following, with identifiable deletions, is the flight surgeon's report:

Personal problems

The pilot's personal life status was in considerable confusion. The following factors are known to have been present—their probable effects and interrelationships will be expounded upon later. They are felt to be of paramount importance.

a. Divorced, 2 children
b. Recent rebuff by estranged spouse
c. Imminent overseas duty
d. Impending marriage
e. Professional status in question

Improper mental or physical state

The following factors were present, and are also highly significant.

a. Personal problems above
b. Lack of sleep
c. Inadequate diet and poor dietary habits

Expediting

This factor was present and contributory, particularly to inadequate diet and will be amplified. The mission, ending in fatality, was originally scheduled for 1300 takeoff, but was discovered within a half hour of the flight to be actually for a 1300 passenger pickup time.

Use of Controls

Present as a factor and directly responsible in causation was improper control usage. It has been established beyond any question that, subsequent to engine failure, the pilot did not enter an autorotative attitude. From careful questioning and analysis of witness statements it is apparent that the aircraft held essentially a level attitude, rose slightly, began to bank to the left, and then rolled over and pitched down almost simultaneously. It is worth mentioning that eyewitness accounts of this accident are almost entirely in agreement with one another. This unusual circumstance makes the gross pattern of events easy to follow and readily believed. It is apparent that the aviator either held pitch or perhaps even raised the collective, thus allowing rotor rpm to reach a critical level. Indeed, from the condition of the rotors and gouge marks, there was practically no rpm at impact.

As to why control usage was incorrect it is felt that psychological factors are predominant. These will be further explored.

Family History

The pilot was the youngest of a large family of brothers and sisters. From many conversations with him, it is possible to state that he had absorbed most of the folklore of his local area insofar as it concerns independence of thought and action. When he made a decision, he stubbornly clung to it until and occasionally even after being proved wrong.

Several local aviators had occasion to meet others of his family. Their consensus is that the family was a closely knit, warm, stable, and loving group. They also state that the deceased aviator was apparently the favorite for all the family members and, in the words of one associate, "could do no wrong."

Education

The pilot was a high school and college graduate, holding a BS degree. At no time during a fairly close association did this examiner ever

hear the deceased discuss his college major. He entered the Army as a graduate of college ROTC.

Military History

Data considered pertinent to this report is as follows: While on another tour, the pilot served under another local officer. The officer referred to is of field grade and an aviator of long standing. He states that during his direct association with the deceased, the pilot became involved in a series of minor incidents mainly consisting of inefficiency and less than complete carrying out of orders, and that it required rather strong personal confrontation to secure good performance. It was about that time or shortly before that the pilot was divorced from his wife.

Personality

The pilot gave the impression of being a mature, stable, dependable, and gregarious individual. In retrospect, he apparently was not nearly as stable as supposed.

Although markedly efficient at those jobs in which he was interested, the pilot had a tendency (common to most humans) to give less than adequate attention to those tasks he felt were not important. This tendency had on occasion required some close attention by his COs and was apparently more than ordinary, and more than was to be expected in a man of his rank, experience, and age. It was not overt shirking, but rather took the form of being readily distracted from or even ignoring those tasks or orders he personally considered not worthwhile.

Maintenance personnel state that the pilot always did a careful and deliberate preflight examination. They do not consider his procedures excessive, or as indicative of undue concern, but rather as the desirable process. This examiner observed such careful consideration for mechanical and weather factors and for safety on flights and on several hunting trips.

As for gregariousness, the pilot was widely and well liked. It would be difficult to find a person who did not feel kindly disposed toward him. He was not the sort of person, however, who appeared over-eager for the regard of others, and it would be extremely difficult to find anyone who knew him with what might be described as intimacy. He was friendly with all, but reserved. Even the man who might be described as his best friend states he never really got to know him deeply. This examiner, for instance, felt rather close to the deceased, but had learned almost nothing of his personal background. He regrettably was not the sort to verbalize his troubles.

During the earlier months of this examiner's association with the deceased, he seemed no more than appropriately lonely, considering that he was a divorced man, lived apart from his family, and occupied bachelor quarters in a somewhat isolated location.

Marriage

As previously mentioned, the pilot was divorced. The divorce took effect several years before the accident. His wife had custody of their two children. During the interval between his divorce and accident, his former wife had remarried and divorced twice. It is probable, from several inconclusive conversations with the deceased, that he was concerned about the welfare of his children. It is known that he made at least two efforts in recent months to re-establish relations with his wife, once during a family reunion, and again at Christmas time. He was rebuffed on both occasions.

Shortly after the last rebuff, the pilot began keeping company with a girl from the local area, and was to have married her on the Saturday following the accident.

Little more is known of his former wife. Concerning the unsuccessful marriage, there is little doubt that a man who is unfortunate in his choice of mates is prone to find himself in other uncomfortable situations.

In direct application to the deceased, every time on which information is available that he had contact or dealings with his wife, he reacted with substandard behavior.

It is probable that the pilot's attachment to his wife and his reactions to her rejections indicate a pattern of frustration and hidden anger expressed in passive/aggressive fashion by failure to devote attention to duty, and by socially less than acceptable behavior.

Recent situation

In retrospect, this examiner, and other persons locally, feel that had we all been more alert the tragedy might have been averted. For my own part, I had not seen the pilot for about six weeks prior to the accident. Looking back, this was a danger signal, as we were close enough friends that hardly a week passed without our meeting, in completely casual style. Others recall the same gradual change and the whole pattern is one of withdrawal and regression strongly suggestive of depression and melancholy.

During the last few months he had begun to omit or neglect duties in the same fashion as during the previously mentioned tour. On one occasion, after a clear briefing and laying out of his course of action, he was quite late for the flight. He had had his job changed in what amounted to job demotion at least twice due to an apparent lack of enthusiasm and concern over his duties. He had neglected to follow certain orders in a fashion so disturbing to his unit commander that punishment had been contemplated.

These events had occurred crescendo fashion in the weeks prior to the crash, and indicate considerable emotional dysfunction. They also doubtless were a source of much stress and turmoil within the pilot and had to be on his mind, even if repressed, as distracting influences.

It is known that on the evening preceding the crash he received a long distance call from his wife. What was said or even the general topics are not known and would be of interest. The likelihood is that he received further distressing news from the call.

For several weeks prior to the accident his personal habits, unknown to most persons, left a great deal to be desired. He had, almost every night, retired between 2100 and 2200, slept (assumedly) until about 0200 or 0300, then gotten up, dressed and gone out, returning about 0630 for duty and staying on the job until the end of duty hours that day. This was not an occasional episode, but a practically nightly occurrence, and outlines his actions as well on the night preceding the crash. Thus he was suffering from chronic fatigue.

The conclusion is inescapable that he had not eaten before the crash since at least supper the evening before. This is supported by the autopsy findings. His name also does not appear on the pay sheet in the mess for breakfast the day of the crash. As to lunch, the fact that the takeoff time was suddenly moved forward prevented him from eating. He had gone to the mess, but had to leave before signing in to insure meeting the flight schedule.

Impressions

It seems clear the pilot was in no condition to fly. Emotionally, as well as physically, he was in such a condition as to make an accident probable.

Two mental states immediately come to mind:

One is the so-called fugue state in which mental mechanisms pop their circuit breakers and relieve the conscious mind of its present burden.

. . . if you can't solve your personal problems or shelve them during duty hours, stay on the ground

This condition is common to all humans and is akin to and perhaps the same as "day-dreaming," "wool-gathering," etc. It is a form of temporary mental withdrawal from reality and has occurred to many persons in automobiles and aircraft who suddenly realize that they have not really seen anything passing by for several minutes. The development of a fugue state is promoted by mental distractions, fatigue, etc., and is a good possibility in the case at hand.

The other state which is considered to be a good possibility is suicide. An urge for self-destruction is likewise not uncommon, although it seldom takes overt form. It is not intended to give an impression of a belief that this pilot willfully failed to take appropriate action in the emergency. It is, however, strongly felt that his pattern of apparent withdrawal and passive/aggressive acts, plus his fatigue and poor diet, indicate a lowering of the normal self-preservatory urges to the point where he would be incapable of fighting off any suicidal impulses that occurred.

It further seems reasonable that, in view of his frustrations and problems, such self-destructive impulses were more likely to occur than normally.

* * *

This excellent report contained other valuable information and recommendations about personal safety equipment. (See "Dress To Live," page 42.) The important thing to learn from this unfortunate case is that all of us are human and subject to human limitations. The person who escapes all personal problems is the rare duck. Most of us face them, in one form or another.

Here are the flight surgeon's recommendations:

"That aviators with problems air them to sympathetic ears, ground themselves, or report to the flight surgeon for temporary grounding.

"That all persons be reminded of the importance of diet and rest."

In short, if you can't solve your personal problems or shelve them during duty hours, stay on the ground!

A CH-47A Chinook recently airlifted an obsolete T-33 jet, weighing 8,400 pounds, from Maxwell Air Force Base, Montgomery, Ala. to Tuscaloosa, Ala. —a distance of 85 miles. The jet is a gift from the Air Force to the city of Tuscaloosa and will be on permanent display at the Junior Chamber of Commerce park.

The Chinook, one of eleven CH-47A aircraft currently assigned to Fort Rucker ferried the jet trainer as part of the U. S. Army Aviation Test Board's User Test Program. The Chinook will probably be used to airlift grounded aircraft from inaccessible areas of the combat zone as well as troops into and out of battle areas.

Hughes LOH Undergoes Flight Test

Two OH-6A helicopters produced by the Hughes Tool Company, Aircraft Division, hover during a current phase of development.

The OH-6A is one of three LOH designs under development for Army competitive flight evaluation early in 1964 against entrants from the Bell Helicopter Company and the Hiller Aircraft Corporation.

The OH-6A uses a 250 hp Allison T63 gas-turbine engine. Its cruising speed is expected to exceed 140 miles per hour.

Airmobile Repair Shop Demonstrated

An Army CH-37B of the 54th Transportation Company lifts a mobile repair shop past a grounded OH-23 during a recent demonstration.

The shop was developed by the Transportation Research Command and assembled by the Army Aviation and Surface Materiel Command. A trailer truckload of tools compressed into a compact box can quickly be placed in hard to reach areas for maintenance and repair of aircraft. Each box can support a platoon of five helicopters.

The box was designed to increase the mobility of the 11th Air Assault Division by providing quicker maintenance response. Still in the development stage, the 4,000-pound box will replace a 23,000-pound mobile van. The shop will provide facilities to do about 70 percent of the work accomplished with the van, but it will not be at the mercy of sometimes impassable or nonexistent roads.

Several types of shops will handle electrical, sheet metal and engine repairs. When opened each is 8 feet high, 7 feet wide and 10 feet long.

The shops conceivably could be used in guerrilla warfare where maintenance facilities are few and far between. A study is under way to determine the feasibility of their use in South Vietnam.

Space-Age Pemmican

HARRY, I'M HUNGRY. Pass me that flap handle and the salt and pepper."

The idea of downed pilots blithely munching on their aircraft as they await rescue is a bit disconcerting at first, but it is a distinct possibility with the recent development of edible structural material.

The material, harder than tempered Masonite, is being developed by Grumman Aircraft Engineering Corporation for possible use as secondary structure—packaging, compartmenting, and control knobs—in future space vehicles and light aircraft.

Survival gear of the seventies might include a recipe book for preparation of the structural snacks.

Sort of a "space-age pemmican," the material was invented by physiologist Dr. Sidney Schwartz and reported in AVIATION WEEK.

"With edible structure available," Dr. Schwartz said, "we can reduce the need for backup food in space flights." Dr. Schwartz said that he received his inspiration from reading how an arctic explorer left mounds of dried fish behind him, which served the double purpose of marking his trail and feeding his sled dogs on the return trip.

With the concept of a dual-purpose material, Dr. Schwartz drew up a list of supplies, which he purchased at a local grocery store for a total outlay of $4.90. The recipe calls for white wheat flour, corn starch, powdered milk, powdered banana and hominy grits—the latter not to tickle the Southern palate, but to serve the same function as gravel in concrete.

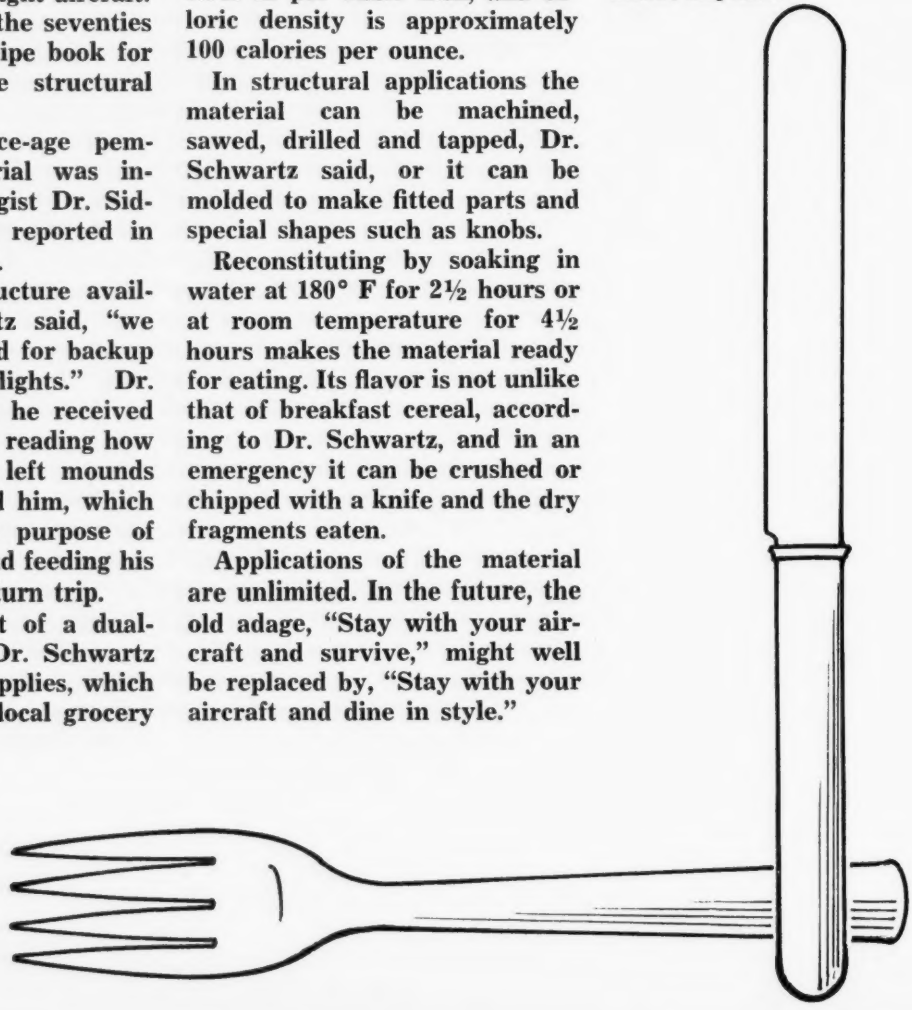
After baking for 9 minutes in a hydraulic press the result was a dark brown, crystalline substance possessing a Rockwell-scale hardness of 87, compared with 80 for tempered Masonite and 120 for sheet lucite. Compressive strength of the material is 7,230 psi, mass density is 0.049 lb per cubic inch, and caloric density is approximately 100 calories per ounce.

In structural applications the material can be machined, sawed, drilled and tapped, Dr. Schwartz said, or it can be molded to make fitted parts and special shapes such as knobs.

Reconstituting by soaking in water at 180° F for 2½ hours or at room temperature for 4½ hours makes the material ready for eating. Its flavor is not unlike that of breakfast cereal, according to Dr. Schwartz, and in an emergency it can be crushed or chipped with a knife and the dry fragments eaten.

Applications of the material are unlimited. In the future, the old adage, "Stay with your aircraft and survive," might well be replaced by, "Stay with your aircraft and dine in style."

Covering the material with a protective coating to be stripped off before using the material as food is being considered. This would maintain the cleanliness and water resistance of the material.

Dr. Schwartz stresses the fact that he has only made two recipes, the first was too brittle before the addition of the hominy grits, and that he felt confident that he could optimize the formula, increasing its mechanical strength, flavor, and nutritional value.

Raspberry flavored altimeter knob, anyone?